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CHARLES W. PRICE
PRESIDENT AND TREASURER
STEPHEN H. GODDARD
SECRETARY
CHARLES T. CHILD
TECHNICAL EDITOR
RUSSELL HOWLAND
GENERAL REPRESENTATIVE

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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

Every indication promises a most successful and interesting meeting of the American Institute of Electrical Engineers at Great Barrington, Mass., in June. A slight change of date has been made, the first day of the meeting being June 18 instead of June 17, as originally stated. The meeting will continue for three days and possibly for four, and the programme of papers will be both varied and attractive. Full information will soon be made public by the committee on arrangements.

LIGHTNING.

Back in the dim period of the dawn of history lightning was regarded as the weapon of the gods, and the brilliant flash was supposed to mark the trail of a thunderbolt. Meteoric stones were picked up in many parts of the world and treasured as the actual bolts from heaven. Even at so late a date as the seventeenth century lightning was regarded with a variety of superstitious awe, and considered to be a manifestation entirely outside of the range of ordinary actions. The stroke of the thunderbolt was still believed to be the direct and visible evidence of the displeasure of the Deity.

It was not until that curiously able philosopher and politician, Benjamin Franklin, made public his conclusion regarding the identity of lightning and the electric spark that the matter received really scientific study and attention. The celebrated kite experiment of Franklin (which is believed, however, to be somewhat apocryphal) took place just one hundred and fifty years ago this summer in fields bordering the town of Philadelphia.

For the last century and a half the study of lightning has engaged the attention of many able investigators, and meteorology has attained the dignity of a science. We now know quite accurately the nature of lightning and the method of production of the enormous electrical pressure exhibited by the flash. When clouds are formed by the condensation of very minute drops of water from the vapor in the air, under certain conditions these drops exhibit a small electrical charge. As the drops coalesce the capacity increases less rapidly than the quantity of charge, for the reason that two drops of equal size, when they flow together, produce one of only slightly larger diameter, and the capacity is determined by the diameter. On this account the drops formed by the flowing together of the small mist particles, long before they attain such size as to be precipitated as rain, acquire an electrical charge of enormous voltage, sufficient often to leap a distance of a mile through the air. This must correspond with pressures only to be indicated by millions of volts.

The total energy exhibited in the lightning flash is not very large. During the immeasurably short duration of the single discharge, or the oscillation, as the case may be, work is done at a tremendous rate, but the duration is almost indefinitely short. Experiments made upon the magnetizing effects produced by lightning discharges have indicated that the total current flow is in the neighborhood of one thousand amperes for a large flash.

No doubt because of the grandeur of the thunder-storm, the brilliant flashes of the lightning and the loud noise of the thunder, the large majority of the human race is timid and nervous and stands in fear of lightning. Notwithstanding the common belief that lightning is very dangerous, the total number of persons killed in a given summer in this country is extremely small in comparison with the population. The number also varies largely from year to year, the last year having witnessed an unusual number of deaths from this cause. The general average seems to be about one death to two hundred thousand of the population each summer from lightning.

The destruction of property by lightning, however, is considerable. In cities it is very small, for the reason that the many metallic roofs and structure of a city seem to rob the lightning of most of its destructive power, even if buildings are struck, and there is also at hand the means for quickly suppressing any fire that may originate from this cause. But in country districts every year a number of barns and haystacks, of dwelling houses and churches, are fired by lightning. For about one hundred and fifty years the lightning-rod has flourished, and

the untenable theory of its operation first stated by Franklin has been taught to succeeding generations. As a matter of fact lightning-rods, as usually put up, are of practically no use. The phenomena of lightning are extremely difficult to predict. The very nature of lightning makes it impossible to conduct experimental work of much value upon it, but about all that is known concerning the action of protective devices may be summed up in the statement that there are no such things. This, of course, does not apply to lightning protective apparatus for electrical circuits, which has been brought to a point of very great perfection and satisfaction.

The problem of protecting a building from lightning is one of no small importance. A tin roof seems to be a fairly good protection, especially if gutter-spouts connected with it are carried to the ground and there joined with buried pipes. Barns containing animals and green hay particularly seem prone to invite the stroke, probably by reason of some difference in humidity or temperature in the air immediately about them. Vessels at sea are rarely injured when it is considered that they are often the only objects in the whole tract of the storm projecting above the general flat surface of the water. Trees differ very much in their attractive power for lightning; thus maples and cottonwoods are struck much more often than oaks, and oaks much more often than beech-trees. The old rules for personal safety, which are the result of experience and superstition in about equal parts, may well be observed, particularly that which cautions the avoidance of trees as places of shelter. The feather bed has no particular lightning-resisting properties, though it has long been cherished as a haven of safety. It is not dangerous to handle scissors and knives during an electric storm, but death has been invited by the use of an umbrella with a metallic rod. Perhaps the best comfort that can be had by the timorous in a thunder-storm is in reflecting upon the extremely small chance of any harm happening to them.

If a person is struck by lightning and falls down unconscious and apparently dead, the chances are, if the injured person be of reasonably strong constitution, that he can be resuscitated. Thousands of people struck by lightning have been allowed to die for lack of attention. The rule is that artificial respiration should be brought about at once. The clothes should be loosened and the well-known movements of the arms and chest made to bring about natural breathing. As in cases of drowning, the work of artificial respiration should be kept up even after those performing it are thoroughly certain the patient is dead. Two or three hours is not too long a time to keep trying. A large majority of persons struck by lightning and apparently dead may be saved by this simple method.

ELECTRICAL ADJUNCTS OF RAILWAY TRAVEL.

Few of the thousands of travelers who constantly come and go upon our railway lines recognize to what a very great extent electricity is used in one way or another as an essential part of the operating system of a modern steam railroad.

Switches and signals are very largely operated by its agency. Train despatching is accomplished through its agency by the use of the telephone or the telegraph. Many modern and well-equipped trains are lighted by electricity, ventilated by electric fans, and have telephone connections made with them at stopping places.

One of the most extraordinary and peculiar facts about railway management is its intense conservatism. There is certainly no other very large interest so conservatively managed as are the railroads, and this conservatism, while doubtless excellent and marking the transportation business as exemplified by railroads one of the most satisfactory that there is, has retarded the development of many new ideas. Perhaps more on this account than on any other it has taken many years for electric train lighting to establish itself fully in the United States. Viewed from practically every standpoint the electric light is the most satisfactory, economical and altogether desirable method of illuminating trains. In case of accident or collision it does not add an element of danger such as is furnished by oil-lamps or gas. The light is steady and sufficient, does not vitiate the air of the cars, and heats it less than any other known illuminant. These facts are slowly being recognized by the majority of railway managers, who are doubtless somewhat accelerated in their decision by the constantly increasing pressure of public opinion in regard to this matter. The traveling public has set the seal of its entire approval upon electric lighted trains.

A recent innovation in luxurious train service comes from the West, where, in some of the larger stations of the great railway systems, a plug-switch arrangement is provided whereby a train standing in the station is put in telephonic communication with the town exchange, thus enabling passengers, while sitting in the train, to converse with any point reached by the long-distance or local service. The telephone has also come into use somewhat as a means for communicating from one part of the train to another. In the case of modern trains, which may be six hundred feet or more in length, this becomes a great convenience.

SOME WIRELESS TELEGRAPHY CONSIDERATIONS.

Cable reports in the daily press of last week stated that two French warships lying off the port of Tunis in the Mediterranean found their wireless telegraph instruments affected by another set of which they were ignorant. Investigation showed that a French lieutenant, quartered in the town of Tunis, had been making experiments in wireless telegraphy, and that the effect noticed was due to the operation of his installation.

Up to the present there has not been a sufficiently widespread use of so-called wireless telegraphy apparatus to bring often within the same range of influence different systems. Only a few weeks ago it was reported that vessels of the British Channel Squadron had picked up signals sent from Mr. Marconi's land stations, and while these things are not, perhaps, reported as often as they happen, still they indicate that certainly up to now there has been no perfection of the system such that signals definitely intended for a particular correspondent shall not be sub-

jected to interference, or to being picked up by a third person.

When one considers the situation with reference to the desirability of a syntonic system, it is obvious that such a method of operation would have almost equal advantages and disadvantages. For marine signaling, which is the field that seems to promise now the largest use for wireless telegraphy, a syntonic system would be practically useless, for the reason that a vessel in trouble or desiring to communicate would be unable to signal another ship provided with a different or differently tuned system. However, if privacy is desirable, then a syntonic system seems to be absolutely necessary. But here again the question arises: How many syntonic systems can operate at once in the same range of activity, and how far may the principle of syntony be carried without interference.

It seems wise to pause and reflect a little concerning the possible use to which this new form of signaling may be put before committing one's self definitely to believe in the extraordinary greatness of its future. So far, although we have well-attested records of Mr. Marconi's successful operation of his system at very great distances, we have not been informed concerning the method of sending employed, nor have any details been made public concerning the installation from which the long-distance waves have emanated. Waiting this, and the fullest statement concerning the method of tuning which he employs, it is well to suspend judgment as to the commercial possibilities and future extension of the ingenious and interesting system of which Mr. Marconi is the author.

STORAGE-BATTERY TRACTION IN BROOKLYN.

It is stated in the newspapers that the Brooklyn Rapid Transit Company is making experiments with a view to devising a system of storage-battery traction for its vast network of lines in and about the borough of Brooklyn. Popular agitation against overhead wires has reached a point such that the municipal government is expected shortly to order the removal of the trolley wires from the streets of that borough. The cost of installing a system of open-slot conduits on the lines of this company, such as are used on the lines of the Metropolitan Street Railway Company in Manhattan, would entail an expense of nearly $25,000,000. It is believed that storage-battery cars can be installed for a much less sum than this.

It is greatly to be hoped that the experiments will be successful. Almost ever since the invention of the storage battery, now more than twenty years ago, the problem of its application to street-railway cars has interested and engaged the attention of inventors, engineers and capitalists. A catalogue of the attempts to operate storage-battery street cars in the United States alone would more than fill this column, yet to-day there is in operation in the United States only a single line of storage-battery cars—that doing crosstown service in Thirty-fourth street in Manhattan and, so far as is known outside the Metropolitan company, still working on a somewhat experimental basis.

The difficulty with the storage battery, heretofore, has been that in such service its depreciation is very rapid. The weight necessary to install upon a car is also so great that track of an unusual strength and stiffness has to be laid and rail-joints are seriously deteriorated by the heavy load on the wheels passing them. These are practically all the objections. The advantages are so great and so evident that they hardly need recounting. A system of traction in which the cars are self-propelling and self-contained, operating upon tracks that require neither the excavation of the earth below nor the invasion of the air above for any essential part of the system, cars capable of going anywhere where there is a track—all this represents the ideal of street-railway service. But the experience of the past does not indicate that the lead storage battery, except under particular conditions, can be used with commercial success as the propelling agent for street cars, notwithstanding the extraordinary success it has won in stationary work. What may be done by new types of battery recently described and not yet in service remains to be seen, but all indications are hopeful and point toward the probable success of street cars equipped with the new type of cells. The experiments in Brooklyn will be watched with the greatest interest by the whole electric railway fraternity.

THE AMERICAN ELECTROCHEMICAL SOCIETY.

The organization meeting of the American Electrochemical Society, which was held in Philadelphia last week, turned out to be a most pleasant surprise to the gentlemen who had fostered the formation of this body. The attendance was extremely gratifying and the interest and enthusiasm so great as actually to surprise those who had looked forward to the new society as a needed body for the representation of this new and most important branch of the electrical industry.

The papers presented at the first meeting were of an order so high that their publication will unquestionably command immediate respect for the new society in all quarters. The constitution adopted is simple. Every indication points to the great success of the movement, and the society will unquestionably take its place at a very early date among the important scientific and engineering bodies of this country.

The papers presented at the first meeting exhibited plainly the existence of a considerable number of earnest students and experimenters in the field of electrochemistry and revealed, to a somewhat astonishing degree, the widespread field that lies fallow before those who are pleased to cultivate it. The success of the society is assured and it should have the heartiest support and cooperation on the part of all its kindred organizations.

A ton of calcium carbide requires 4,500 kilowatt-hours of energy for its manufacture and gives 10,000 cubic feet of acetylene. In burning, this gas gives out 250,000 candle-hours of light. The same amount of energy would produce 1,440,000 candle-hours if consumed in incandescent lamps, about twice as much if used in Nernst lamps, and nearly five million candle-hours if used in working open-arc lamps.

THE COMMERCIAL MEASUREMENT OF ELECTRICAL CONDUCTIVITY.

BY LAWRENCE ADDICKS.

In the laboratories of those who handle refined copper in any form, the electrical conductivity has become, perhaps, the most important criterion of its purity. This is due largely, on the one hand, to the fact that the great majority of copper is finally put to electrical uses, where the conductivity will be one of the main requirements of the specifications, and on the other, to the rapidity with which this delicate test of the purity of copper may be made. The interpretation of the results is beyond the scope of this paper, the writer wishing to confine himself at present to a review of the methods and apparatus for the measurement of conductivity and a brief discussion of their respective merits.

Electrical conductivity is almost invariably stated to-day as a percentage of the conductivity of pure soft copper as measured by Matthiessen forty years ago. Since that time much purer specimens of copper have been prepared than were then obtainable, so that samples of the purest soft copper may sometimes reach, perhaps, 103 per cent of his now arbitrary standard, though that figure is far above the range of the commercial product. This standard is variously stated as the value of a metre-gramme, a mil-foot, a centimetre-cube, etc., in different branches of industry. It is evident that conductivity, or its reciprocal, specific resistance, may be stated in terms of length-mass or of length-section measurements. While it would seem at first glance that the different values were mutually convertible, this is not true except at the expense of the precision of the results, as Matthiessen did not measure the specific gravity of his samples, and we have to rely upon the diameter measurements of the small wires that he used (under 0.7 mm.) to compute the section. Therefore, a length-mass unit is the more reliable, and Matthiessen's results are usually stated in terms of the metre-gramme. This standard is:

M = 0.14172 international ohm at 0° centigrade.

Matthiessen studied the temperature coefficient of his samples, and the following equation, according to the late Professor Holman, gives results between 0 degree and 30 degrees centigrade, which agree with these experiments within one one-hundredth of one per cent, or further than the original data are reliable:

$$M_t = M_0(1 + 0.003879\,t + 0.00000526\,t^2)$$

By means of this formula, we may compute M_t for a temperature t at which a conductivity measurement may be made, and $\frac{1}{M_t}$ will represent the standard of which the unknown sample is a certain per cent. If we now find the resistance of a certain length L to be R_t, and the mass of this length to be W,

$$\text{the specific resistance} = R_s = \frac{R_t W}{L^2}$$

$$\text{the absolute conductivity} = C_a = \frac{1}{R_s} = \frac{L^2}{R_t W}$$

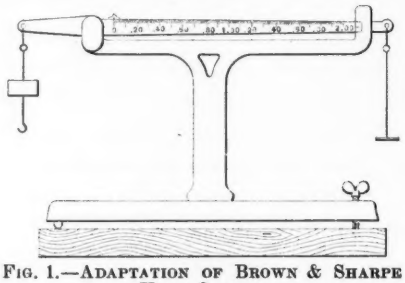


FIG. 1.—ADAPTATION OF BROWN & SHARPE YARN SCALES.

and the conductivity relatively to the Matthiessen standard

$$= \frac{C_a}{\frac{1}{M_t}} = C_a M_t = \frac{M_t L^2}{R_t W}$$

Similarly, for length-section measurements, for sectional area A,

$$R_s = \frac{R_t A}{L} \text{ and } C = \frac{M_t L}{R_t A}$$

These are the formulæ which form the basis of all conductivity determinations,

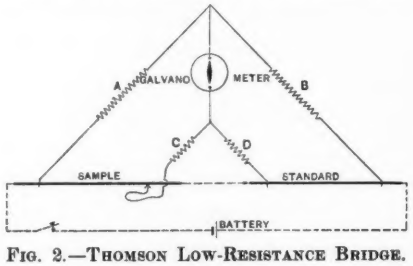


FIG. 2.—THOMSON LOW-RESISTANCE BRIDGE.

the different methods consisting simply of different ways of determining R_t.

It is customary to state the conductivity to the nearest tenth of a per cent. Let us consider for a moment the precision with which the component measurements must be made to warrant this. For a formula of this type we have, from the method of least squares,

$$\Delta^2 = \delta^2_1 + \delta^2_2 + \delta^2_3 + + \delta^2_n$$

where Δ represents the fractional error in the result, and δ_1, δ_2, etc., stand for the fractional errors in the factors 1, 2, etc. Taking $\Delta = 0.001$ and $n = 2$, we have for equal effects,

$\delta_1 = \delta_2 = 0.0007$ or about 0 07 per cent. With great care this precision may be obtained in R_t and is easily obtainable in W, but in the case of A it is quite difficult, which offers a further objection to length-section methods. It is doubtful if this precision is reached in the commercial laboratory, however, and it is not necessary that it should be, 0.2 per cent being plenty close enough for all practical purposes.

We may now pass on to the practical methods of measuring R_t and W or A, as the case may be. The only commercial method of obtaining A is by diameter measurements at numerous points and in various axes with a micrometer-caliper reading to one ten-thousandth of an inch. Considerable care and skill are required as the average wire is far from being an ideal cylinder, and a given error in diameter gives twice as great a fractional error in the area computed from it. With fine wires this error may become very large.

W may be very rapidly and accurately measured. A delicate chemical balance is unnecessary. The writer has adopted a modified form of the yarn scales manufactured by Brown & Sharpe, the total cost of which is about $10. The poise reads to 0.01 of a gramme and the largest weight is 200 grammes. (See Fig. 1.)

The methods of measuring R_t may be classified in general under the following heads:

1. The Wheatstone bridge.
2. The slide wire bridge.
3. Voltammeter methods.

THE WHEATSTONE BRIDGE METHOD.

This very simple method consists in measuring the resistance of a known length of the wire in question on a Wheatstone bridge. The temperature of the wire, as well as of the bridge, must be ascertained and the method is not directly applicable to heavy wire, owing to the awkwardness in handling any considerable length and the error due to contact resistance. The latter can be avoided, to a certain extent, by using a pair of clips for the potential leads to the bridge, clamping them on the wire close to the bridge binding-posts which serve as current leads. The method is open to the usual objections to the Wheatstone bridge for the measurement of very low resistances, the excessive ratios required diminishing the sensitiveness so that the limit of practical use is about 0.01 of an ohm, which corresponds to about twenty-six feet of No. 6 Brown & Sharpe copper wire, for example. It was formerly the custom to measure great lengths of wire,

one one-hundredth of a mile, or 52.8 feet, being a common specification. There is no good reason for this and it makes a very clumsy sample to handle. To-day eighteen inches to three feet is the length taken even for trolley wire and one-half-inch rods. Three feet should be as representative of a coil of wire as fifty, unless the sample be taken at the very end of the coil when leaving the drawing machine. If there is any reason to suspect a lack of uniformity, it is much simpler to cut short lengths from several parts of a coil and test them by one of the more rapid methods presently to be described.

THE THOMSON LOW-RESISTANCE BRIDGE.

This modification of the Wheatstone bridge avoids all of the troubles due to contact resistance noted under the last heading. It is usually represented by the conventional diagram, Fig. 2. A and B and C and D are resistances which are made either equal or in some known ratio and the length of the sample is varied until a balance is obtained, giving the length of the sample equal to the resistance of the known wire marked standard. In reality it is a drop of potential method along two wires in series, and the contacts are in series with the comparatively high resistances, A, B, C and D, and are therefore negligible. By adjusting the ratios any size wire may be compared with the standard and to avoid excessive ratios several standards may be used.

A modification of this method, developed by Professor Puffer, of Boston, has been more or less used for this work. He used some twenty feet of wire, enclosing it and the standard wire in a long box and, if necessary, blowing a current of air through the box to maintain a uniform temperature. The scheme of the apparatus is shown in Fig. 3. A and B and C and D correspond to the bridge resistances in Fig. 2. Owing to the rearrangement of the connections, however, but a single setting of the sliding contact is required to obtain the length of the sample equal in resistance to the standard. A and B are equal resistances of, say, 100 ohms, wound on the same spool to ensure their always being at the same temperature. C and D are similar to A and B. The wires are now in parallel instead of in series, but the contact resistances are taken care of as before.

In both the Thomson bridge and the Puffer modification, the temperature may be neglected provided the sample is of the same metal as the standard and also that they are both at the same temperature. In this case M_t is taken at the temperature at which the standard has the resistance R_t; this assumption being that the two wires have the same temperature coefficient.

THE SLIDE WIRE BRIDGE METHOD.

This is the method in use in most laboratories at the present day, and it will be well to examine it in detail. Fig. 4 shows a diagram of the connections as usually made. A and B are equal resistances of about 0.1 ohm. C and D are equal resistances of, say, 0.01 ohm, which is the smallest resistance used in connection with the instrument, and is of a

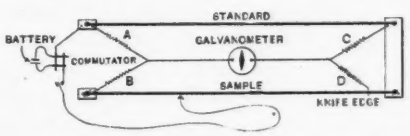


FIG. 3.—PROFESSOR PUFFER'S MODIFICATION OF THE THOMSON BRIDGE.

magnitude easily standardized with precision. The sample serves as the slide wire and is attached by suitable clamps. A series of resistance coils E are wound for use with samples of different sizes. Their function is to shunt the resistances C or D, thus moving the slider balance to the right or left, as the case may be. It is evident that, when the sample is in place and no resistance is shunting either C or D, the galvanometer will show no deflection when the sliding contact is at about the middle of its range, showing that the same potential exists at the electrical centres of the divided circuits. If now we introduce a resistance E we destroy that balance and the contact must be moved until the proportion of the sample wire on one side is greater in resistance than that on the other by an amount equal to this unbalancing. Suppose, for instance, that we have a piece of No. 12 Brown & Sharpe copper wire in the

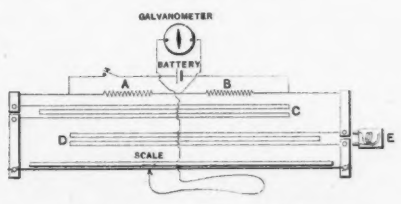


FIG. 4.—SLIDE WIRE BPIDGE METHOD.

bridge, which usually takes about a three-foot length. The resistance per foot will be about 0.0015 ohm, or about 0.004 ohm between the extreme convenient positions of the slider. Let us now introduce at E a resistance that will change C by about 0.004 ohm. C = 0.01 ohm, and E will be found by the law of divided circuits.

$$C - 0.004 = \frac{CE}{C + E}, \text{ or } E = 0.015 \text{ ohm.}$$

Therefore, we should pick out a resistance from the set furnished with the bridge of about 0.015 ohm. These coils are usually marked, however, with their effective resistances, or in this case about 0.004 ohm. The side C would now be unbalanced by 0.004 ohm. Moving the slider to the extreme end from C a new balance would be found, for this would cut a length of the sample equal to 0.002 ohm out of C and put it in series with D. The resistance E would now be placed in parallel with D and the slider moved to the other end of the bridge and another balance found. The difference between the two scale readings would give the length of the sample wire equal to 0.004 ohm. As all of the resistances, including the sample, are of copper, the temperature need not be taken into consideration, the effective value of E being taken as R_t, and M_t being taken at the temperature at which the bridge coils were originally standardized. The slider is provided with a vernier reading usually to thousandths of feet. The connections for E are made by means of large mercury cups. We now have values for M_t, R_t, and L, and it remains to find the weight of length L. In practice, when measuring many samples, it is not convenient to cut the wire exactly to L, which will probably be some odd thousandth of a foot, but it is better to take a whole number of about the same magnitude as L, such as 2.700 feet, which we will call L′, and find its mass, W′. The error introduced is inappreciable, the assumption being that the mass *per unit of length* is the same for 2.700 feet of wire as for, say, 2.642 feet, and there is a much less chance of error in marking the length. L′ may best be measured by scratching the wire at two points on the bridge scale by moving the wire sideways beneath the knife-edge of the slider, say, at 2.800 and 0.100 for the 2.700 taken in illustration, then taking the wire out, clipping it with cutters just outside the marks and carefully filing the ends flat to the exact length. One end of the wire is then bent into a hook and it is weighed on the scales shown in Fig. 1.

The formula is now $C = \frac{M_t L L' K}{R_t W'}$,

the K being a constant equal to $\left(\frac{12}{39.37}\right)^2 =$ 0.09289, due to the fact that L and L′ have been measured in feet instead of in metres. Taking the complete calculation, we have, assuming the bridge coils to have been standardized at 18.8° centigrade,

t = 18.8° centigrade.
R_t = 0.004000 ohm.
L = 2.642 feet.
L′ = 2.700 feet.
W′ = say, 25.00 grammes.

$$M_t = 0.14172\ (1 + 0.003879 \times 18.8 + 0.00000526 \times 18.8) = 0.1523.$$

K = 0.09289.

$$C = \frac{0.1523 \times 2.642 \times 2.700 \times 0.09289}{0.004000 \times 25.00} =$$

100.9 per cent conductivity.

Should frequent use of the apparatus warrant it the calculations may be worked out into a more condensed form. The formula may be reduced to $C = \frac{LK'}{W'}$ where K′ must be figured out once for all for each bridge coil. In the case above, for instance:

M_t = 0.1523, a constant for this bridge.
L′ = 2.700, a constant by hypothesis.
K = 0.0929, a constant by derivation.
R_t = 0.004000, a constant for this coil.

Then $K' = \frac{M_t L' K}{R_t} = 9.550$, and $C = \frac{9.550\ L'}{W'}$.

Precautions—The method assumes uniform temperature for all the resistances, and great care must be taken that temperature disturbances do not occur, as the measurements themselves give no indication of the condition of the apparatus in this respect, unless the sample wire is left in position for a considerable time and check measurements taken. The sample should be handled as little as possible in putting in the bridge. Any draught or sudden changes in room temperature must be avoided. Resistances E, being usually close-wound coils, will lag behind the sample and C and D, which are exposed, in the event of any such changes. The current passed through the bridge should not exceed that furnished by one or two dry cells of battery. Any differences in check settings on a clean wire is proof positive of unstable temperature conditions. It is always well, before using the bridge for a set of determinations, to try a setting on a standard wire to see that the bridge resistances are at a common temperature. The resistance E should be handled as little as may be and its mercury contacts should be kept well amalgamated and scrupulously clean.

The galvanometer should be of the d'Arsonval type of low resistance and with a light system. The mistake is often made by instrument dealers of furnishing for this work a galvanometer with a system weighing twenty-five or thirty grammes. This heavy system has more or less of a ballistic action and can not be made truly dead-beat, a feature which is very essential to rapid work.

The connections shown in Fig. 4 are simple, but are subject to error due to any capacity or inductance in the apparatus. This error due to this cause is, however, inappreciable in most instances. It may be avoided by using the double-leaf Wheatstone bridge key with an extra short-circuit contact to damp the galvanometer, but delay in reading from thermo-electric troubles is apt to follow.

VOLTAMMETER METHODS.

These consist of various fall of potential methods with portable instruments. For general conductivity work they are to be avoided on account of the abnormal current densities necessary to bring the drop within the range of a portable millivoltmeter. The simplest of these methods is naturally some combination of a millivoltmeter with a low-range ammeter, but the question of accuracy of calibration enters here and is best avoided by sticking to zero methods. For general wire mill-work it is hard to improve upon the slide-wire method just described, but

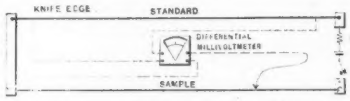


FIG. 5.—DIFFERENTIAL METHOD.

for special work a zero millivoltmeter method is much more rapid and sufficiently accurate. A case in point is the work in the laboratory of a copper refinery. Here the conductivity is measured on many samples daily, in a large works, the result being desired as an indication not of the properties of particular pieces of wire but of the quality of the lots of copper they represent. Here the wires are always of the same size and material and the range of conductivity is very small. To handle a case of this character at the Raritan Copper Works, the writer has recently constructed a special apparatus designed to shorten the time required in testing at every possible point. It is an adaptation of a well-known method of comparing low resistances and consists in putting the sample and a standard wire in series and comparing the respective drops in potential along the two by means of a differentially wound millivoltmeter, the length of the sample being varied until the millivoltmeter shows a zero reading. About six feet of No. 12 Brown & Sharpe wire are used as a sample with a current of ten amperes. This current if left steadily on would bring the temperature up, perhaps, ten degrees centigrade, but for the length of time necessary for a determination—a half-dozen closures of the battery key for less than a second at a time—the rise is about a couple of tenths of a degree. It must be remembered in this connection that the sample and standard wires are in series and only differences in temperature between the two wires would affect the results. So it may be readily appreciated that the rise occasioned makes no trouble.

The millivoltmeter was wound by the Weston Electrical Instrument Company and is of its standard type, with the exception of the double winding, which is brought out to four binding-posts. The sensitiveness is approximately a needle deflection of one mm. for a difference of potentials applied to the two windings of 0.0002 volt. The resistance of either coil is about 0.8 ohm, and the maximum safe potential about 0.08 volt, which corresponds to about ten amperes through between five and six feet of No. 12 Brown & Sharpe wire. As the instrument can be read much more closely than to one mm., one-tenth per cent of the wire length may be easily obtained. The voltmeter may be tested at any time for differentiality by a reversal of the connections in the usual way. After the length giving zero deflection is observed, the wire is instantaneously cut to a predetermined standard length by a shear attached to either terminal and weighed on the yarn scale shown in Fig. 3. If desired, the computations may be tabulated so that, knowing L and W′, the only variables, we can at once find C. The constant, K′, is determined once for all by measuring L and W′ for wire of known conductivity. By remeasuring this constant from time to time the apparatus may be rapidly and accurately checked. Should it be desired to place any switches in the voltmeter lines they should be in the form of large mercury cups, as the 0.8 ohm in the instrument is not sufficient to satisfactorily eliminate more than the single set of contact resistances at the sample wire. The leads from the standard wire had best be soldered. No trouble will be experienced with the millivoltmeter, as the changeable parts—namely, the magnets and springs—should they vary, would simply shift the zero. The speed of operation is only limited by the time it takes a sample wire to recover from the temperature effects of handling when put into the bridge—two or three minutes. The balancing, weighing and computation can all be accomplished in about two minutes. Changes in room temperature affect the two wires equally and cause no trouble. Fifteen wires an hour can easily be handled, including the computations, and a skilled observer is not necessary.

Some Telephone Questions.

Papers and Discussion at the One Hundred and Sixty-Third Meeting of the American Institute of Electrical Engineers—Concluded.

THE TELEPHONE STATUS QUO—*Concluded.*

BY ARTHUR VAUGHN ABBOTT.

In possession of a country of unbounded resources, the American public is of all peoples the easiest and most tolerant to deal with. It has made money and it expects and wants every one else to do likewise. It is good-natured and somewhat careless as to what it pays, provided good goods are returned, and charges that are equitable and just to all made. But woe betide those who attempt to get something for nothing, or to discriminate unfavorably between different portions of society. Their fate is certain.

It is this innate feeling that has instituted the revolt against the flat-rate system. One does not contract by the year with the milkman for all the milk the family can drink, or with the butcher or baker for all the bread or meat, or with the gas company for all the gas one wishes to burn. The electric light people even go so far as to install a demand meter, scaling bills not only upon the quantity of electricity used, but considering also the time at which it is asked for. To charge a subscriber who makes 100 messages per day the same rate as one who makes ten is obviously unfair, and driven from the illogical flat-rate system, the plan of an initial charge, plus a message rate for all calls beyond a certain annual number, has gained considerable currency. That this is an improvement and more just than the former method can not be gainsaid, but even this scheme contains large elements of manifest injustice, for the message is no more the true unit of charge than going to a livery stable and hiring a carriage to take a drive would be a fair basis for the stableman; for one customer might be gone an hour and another all day. The average length of telephonic conversations is about two minutes, but averages are dangerous. In one case under the personal observation of the writer, a young bride on her return from the honeymoon kept the line leading to her mother's house busy for several consecutive days for more than forty minutes at a time. Query: Shall the bride be charged ten cents for her call and you the same price for two-minute conversation? No; the message-rate system, while approximating more closely to the truth than the flat rate, is still on a false basis and should be corrected.

In giving service, telephone companies do three entirely separate and independent things which are incommensurable with each other, all of which every just and equitable tariff must recognize and express.

First—The telephone company supplies and maintains a certain amount of apparatus necessary to connect each subscriber with the central office. This apparatus must be furnished and cared for whether used or not, merely to give the subscribers an opportunity to call. The quantity and quality of this apparatus do not vary with the load, being the same whether the instrument is used once a year or 100 times a day. A flat-rate annual tariff sufficient to pay interest, depreciation and maintenance on this portion of the plant is fair and just, and by recognizing varying lengths of subscribers' lines, this charge can be made exactly proportional to the requirements of each station.

Second—The telephone company must maintain a corps of operators to answer subscribers' calls and to perform the necessary avocations of connecting subscribers together. This expense is directly and only proportional to the number of times each station calls.

Third—During each conversation, battery is supplied to the subscribers' station for talking, cords, plugs, trunk lines and other common apparatus are in use, the amount and cost of which are proportional to the length of time of conversation.

Therefore, any telephone tariff to be fair to all must recognize these three factors, and in so far as any one is omitted, and a blanket charge substituted therefor, injustice will be done, depending on how far the service rendered to a particular station departs from the general average.

To perceive the bearing of this proposition, consider for a moment the cost of installation and service. According to previous telephonic policy, the ratio of the number of telephones to population is very low, as is shown in table II. Consequently, the installation cost per station has been high. In large cities this has varied from $150 to $250 per station. In medium cities, of say 200,000 population or so, from $90 to $125, while even in the smallest towns it is rare to find a cost of less than $50 per station. Of the installation cost from $10 to $25 is required at the substation, depending upon the character and difficulty of wiring. From $15 to $50 for the switchboard, varying with the type of board, size of multiple and percentage of trunking, while the wire plant has absorbed the balance; but if by a more liberal policy the use of the telephone could be so stimulated as to raise the population ratio, to say fifteen per cent, it would be possible, even in such a city as New York, to install a telephone plant at a cost not to exceed $60 per substation, as is shown in table III.

Probable installation cost per station of a telephone plant, sufficient to serve fifteen per cent of population.

TABLE III.

Items.	Cost.
Substation apparatus	$15
Wire plant, subscribers' lines	14
Wire plant, trunk lines	7
Switchboard apparatus subscribers' lines	12
Switchboard apparatus, trunk lines	6
Total	$54

Assume now that an installation charge of $15 per year per substation were made against each one-party line to cover interest, depreciation and maintenance, $10 per year per station each against two-party line and $8 per year per station against each four-party line, and that a charge of one cent was made for each time the central office was called up and one-half cent for each minute of actual time that the telephone was in use. Large business houses and the best class of residences would take one-party lines. Smaller business houses and medium residences two-party lines, while the bulk of subscribers would use four-party lines, all of these being arranged with selective signals and lockouts to secure the best quality of service. Simply to illustrate the effect of this system of tariff, assume one-party lines to average ten calls per day, two-party lines seven and four-party lines three. Under these circumstances, one-party lines must bear a tariff of $75 per year, two-party lines $52 and four-party lines $23. According to this suggestion, the annual cost of maintenance and depreciation on plant would be cared for by the annual flat-rate charge, which, for this purpose, is sufficient in a properly installed and maintained plant. The receipts from traffic would average $20 per thousand calls, while the actual expense should not be over $7 per thousand calls. The difference of $13 would be ample to pay reasonable general expenses and dividends. At each substation a meter would

be installed, carrying two dials, one showing how many times the exchange is called, and the other the total time expended in the use of the telephone. This meter should be in plain sight of the subscriber, so that he, at any time, could check the readings with his own watch. Such a device could be made and installed at an expense not to exceed $3 per station. Each station would be charged for exactly the service rendered, and it would be optional with all to regulate charges to suit their wishes.

It is probably an impossibility to make any one method of charging absolutely universal, any more than it is feasible to crowd all passengers on a railway into one car. There must be Pullmans, coaches and emigrant cars. So every telephone company must probably supply a few flat-rate instruments, many meter rates and some coin boxes. *"Chacun à son goût,"* but the main idea is that of producing a rate that will be absolutely just, and be capable of so stimulating telephonic business as to place an instrument in every house. Each community contains some chronic objectors that it is impossible to satisfy, but setting such aside, it seems that a scheme of this general nature would go far toward smoothing out the existing friction between the operating companies and the public.

But with this discussion of the commercial aspect, the engineering side must not be entirely forgotten. Two very curious tendencies are observable. Among the older companies and the most advanced of the Independents, those to whom experience has read some bitter lessons, there is a very strong inclination to design plants with the utmost care and skill, using the widest and best experience for the purpose, and foreseeing the future as far as possible. This is in marked contrast to the practice of a decade ago, when telephone plants, like "Topsy," simply grew, and in many respects were not unlike the dark heroine of Uncle Tom. But with the newer and less experienced of the Independents, there is a most conspicuous absence of design. Because some farmer has talked half a dozen miles over barbed-wire fences, a lot of little telephone companies immediately built toll lines of No. 10 or even No. 14 iron wire on poles about as large as a walking stick, with grounded lines, through trolley towns, and wonder why their subscribers complain of poor service, or that their lines go down with the first snow.

Conduit construction has settled into pretty well recognized channels, involving chiefly the use of vitrified clay pipe, particularly the multiple duct forms. Periodically, a new and improved form of duct material appears destined to supersede all others, but I notice the tile men serenely go their way, and their output to-day is larger than ever.

The construction of aerial lines is rapidly becoming systemized and proceeding under standard specifications, the tendency of which is to build the lines much more efficiently and much more solidly than in the past, and to restrict the use of open wires to three or four cross-arms.

There is a notable tendency to increase the size of cable. Formerly 120 pair was standard for underground work and twenty-five for aerial, but at present 200 pair is becoming almost universal, and even 400 pair has entered the field underground, while aerial cable has grown so that 150 pair is not unknown. For trunk lines and toll work, large conductor, low-capacity cables are to the front, even to the extent of using No. 16, No. 14 or even No. 12 wire, with capacity of from 0.06 to 0.05 M. F. per mile. In switchboard practice, the common battery automatic signal-board is rapidly expelling all other forms and soon will apparently reign supreme, for at present there is not a shadow of rival looming on the telephonic horizon to dispute its supremacy. While switchboards of this type are a vast improvement over those of older construction, they still leave much to be desired, and the entire telephonic fraternity wait with open arms the coming of the perfect switchboard. There are many who believe that a purely automatic board will offer the desired solution, but during the past decade the progress in this direction has been almost infinitesimal. A central office seems to be one of those things that needs the human element, and can not be made purely mechanical. Possibly, the recently invented Faller mechanical operator may form at least a partial solution.

For the substation there is no progress to report. The transmitter, receiver and magneto have remained in *statu quo* for ten years, save that each manufacturer dresses his apparatus in a newer and possibly more fanciful design. This is strange when is considered that actual telephonic efficiency is less than two per cent, and that a very slight improvement in this direction would be hailed with delight by all, particularly by those who do much toll work. Part of the difficulty lies in the electrical characteristics of the line, and for this Dr. Pupin's epoch-making discovery is supposed to be a panacea, but as yet results from practical experience therewith have not been reported.

In the light of the present, what is the earnest of the future? Despite the hints of our friends of the Hertzian waves, there is nothing at present to suggest any radical discovery in the telephonic field. On the other hand, the art is gradually settling down to that inevitable and comfortable basis wherein sound financial judgment as to the expediency of a telephone plant, skillful engineering in design, the best possible construction, good business management in operation, fairness in the tariff and in the treatment of the subscriber, will be absolutely essential to produce a good balance-sheet. Toward this haven strongly sets the current of popular opinion, aided by those who are most broad-minded and liberal in the business. May the art safely reach this port, avoiding both the Scylla of a disastrous rate war and the Charybdis of financial wreck from rash, ill-advised investments, poorly constructed and operated.

At the Chicago meeting of the American Institute of Electrical Engineers the following paper was also read:

TELEPHONY—1902.

BY ANGUS S. HIBBARD.

It is apparent to any one familiar with the subject that, at the present time, the telephone in the United States, both in a technical and a commercial sense, is advancing at top speed, in a course of development whose limitations no one will attempt to forecast.

Retarded originally by the then best-known system of charging for service, the so-called flat rates which, in providing for patrons of the same class one line, one telephone and unlimited service, necessarily exacted as much from the smallest as from the largest user, the growth of exchanges throughout the country was comparatively slow. This may have been for the ultimate good of the service generally for, during this period, it was possible to devise and test out the many combinations of operating appliances which have resulted in the standardized machinery of 1902.

Ten years ago no one conceived of the elaboration and comprehensiveness of the plant which makes the present-day service possible. In hundreds of exchanges the present daily traffic could not, with the same number of lines and instruments, be carried on with the apparatus in use ten years ago.

Automatic signaling appliances (meaning the control by the subscriber, with his telephone switch-hook, of the operating signals necessary for call, recall or disconnections) and the central station or common battery used for all signaling or

talking, have made possible the rapid and certain operations now essential to the service.

The long-distance lines first developed around local centres were, in this period, gradually pushed out until the ends met in every direction and the exchange, once local, became almost national in the extent of service possible to the user.

At this time it had been demonstrated that the most satisfactory and universally popular unit upon which to base charges for service in large exchanges was the message and, upon the introduction of that basis of charging, and especially by the arrangements of the patron's apparatus so that payment might be made at the time service was rendered, exchanges in all the prominent cities in the country began to grow at a phenomenal rate.

The telephone was no longer a luxury limited to the service of a selected few, but being made available to all classes of users, large and small, became an agency of greatly extended usefulness throughout the entire community.

Just as rapidly as it was possible to provide for the service to be rendered, classes of rates were made which were availed of by the public in ever-increasing numbers extending even so far, in some cases, as to the patron who may use the telephone not more than once a day.

It is needless to say that engineering and construction forces have been taxed to their utmost to keep pace with such a growth. Subway plans which had been considered sufficient for many years future growth were, in some cities, doubled and trebled in extent.

Permanent exchange buildings were erected and equipped with the greatest possible speed. Cable plants were increased, in respect to the mileage of wire, in a number of cases more than 100 per cent in one year.

The figures of the year 1901 present a remarkable study. In New York (Manhattan) the total number of telephones reached 69,361.

In Chicago the net growth for the year in the number of telephones exceeded the total number operated at the beginning of the year 1898.

In the San Francisco exchange 30,214 telephones were in operation at the close of the year, being one for every 11.3 of population.

While such a large amount of work has been under way and such vast sums of money have been expended in the extension of the service, it is gratifying to note that engineers from other countries who have been devoting themselves to a study of the problems involved have agreed with the practice and plans of the so-called Bell companies in America and have adopted their methods.

Probably the most extended investigation of this character ever made was that of the engineers of the British Post Office Department who, after months spent in study and travel in this and other countries, recommended as the basis of charge the payment for service by the message, and for small users the payment for service at the time it is rendered, using coin-receiving devices or so-called slot machines for that purpose. They also recommended for the rendering of the service the use of the relay multiple switchboard and trunk-line switching machinery as designed and manufactured for the Bell companies in America.

While to the promoter, the manufacturer of apparatus and, especially, to the manipulator of securities, the extension of so-called "independent" telephone schemes has continued in some localities to seem attractive, there are many signs that the public is finding out gradually that these enterprises are designed for the immediate benefit of the few who are furthering them rather than for the extended or lasting good of a community.

The superintendent of the department of electricity for the city of Chicago has shown in a recent report on telephone service and rates that in Cleveland, Ohio, where the largest "independent" exchange has been in operation, the subscribers who have the telephones of both companies could pay for those who have the opposition service only, the difference between their present rates and the highest rates charged for the same service by the Bell company, and by thus having all telephones connected with one exchange, secure all the benefits of their present service, be relieved from its disadvantages and save more than $400,000 per year.

The present apparent merits or demerits of two or more telephone systems in a city or town *versus* one embracing all users are questions which do not seem to call for extended considerations in looking broadly at the future of telephony. It will be difficult to controvert the conclusion that telephone service, as nearly as possible standard in its efficiency and cost, will be of the greatest good to the greatest number when rendered by means of one comprehensive system, national or even international in extent. To provide for the requirements of such a system will be a task which will engage the best efforts of telephone engineers throughout the world. If one thinks the subject a limited one let him consider that present accomplishments mark what were but a few years ago considered extreme possibilities.

In the item of cable construction, ten years ago, conservative engineers recommended fifty pairs of wires as the greatest number advisable to be contained in one cable. To-day many cables are in use containing 400 pairs or 800 wires. Less than eight years ago electric lamps were first used for signaling purposes on subscribers' lines; to-day not less than 500,000 lamps are used for this purpose and light and flash many million times each day.

While the general lines of development seem now to be well defined the details necessarily involved in the performance of the service required are almost unlimited in number and present to the engineering and executive forces involved problems of the greatest intricacy and interest. The introduction of the brilliant discovery of Pupin to general practice; the simplification of the apparatus used in every branch of operating work; the designing of trunk-line plans and methods so that the greatest efficiency and economy may be accomplished; further development and improvement of plans for wire distribution; the designing of a satisfactory automatic message recorder, a simple and satisfactory composite or duplex telephone circuit and a practical telephone repeater; these are a few of the problems requiring the best efforts of our engineers.

Some Rules for Casting Aluminum.

In a recent issue of the *Foundry* some rules for casting aluminum are given by Mr. H. Tuttle. The metal should be poured as cold as possible, thin castings being harder than those of heavier sections, but on general principles the rule holds good in all cases. A convenient way of ascertaining the temperature of the metal is to stir it with a pig of aluminum if its color is red until it is white, the melting of the pig serving as a guide to this point. The end of the cooled pig is then dipped three-quarters of an inch or so into the metal, the aluminum chills around the pig, and when the latter is withdrawn from the melted metal it remains like a little cup on the surface of the handle. The time required for this chloride metal to melt gives a good idea of the metal in the crucible. Dry sand is to be used and sponging the mould is to be avoided. The metal is to be poured very rapidly, as it is not as liable to wash away portions of the mould as other metals on account of its lightness. It is not necessary to ram the moulds nearly as hard as for iron. Soft ramming will prevent the breakage of castings, as aluminum just after it solidifies is very weak and crumbling and will scarcely bear its own weight.

HOMBURG-SAALBURG MOUNTAIN ELECTRIC RAILWAY INSTALLATION.

BY FRANK C. PERKINS.

The necessary current for operating the mountain railway from Saalburg to Homburg is supplied from a central power and lighting station located at the latter place, which is a celebrated resort in the Taunus Mountains. The Homburg Electricity Works was originally constructed for lighting and power purposes, and was installed upon the three-wire system. The interior of the engine-rooms of the Homburg plant may be seen in the accompanying illustration, Fig. 1, while Fig. 2 shows a generator set installed by the Elektricitats-Actien-Gesellschaft, formerly W. Lahmeyer & Company, of Frankfort, Germany, which is of more than passing interest. This firm was among the first to construct direct-current generators of a design which would allow direct coupling to high power, vertical or horizontal slow-speed engines without the use of an additional flywheel. This is accomplished in this particular unit by placing on the engine-shaft two machines, one for lighting service and one for traction work. The generators differ in size and the traction generator acts as a flywheel to the entire set. These dynamos are both direct-current machines of multipolar construction, the brush-holder rings being adjusted by hand-wheels conveniently located. The engines were constructed by the firm of Sindinger Eisenhutte, of Sundrig, Western Germany. The engine driving the traction set in the central power station at Homburg is of the vertical compound type and has a capacity of from 250 to 300 horse-power. The original installation of this plant included three direct-coupled continuous-current generators and engines having each a capacity of ninety kilowatts at a speed of 160 revolutions per minute, together with a further set of 300 horse-power, seen in the accompanying Fig. 1. The switchboard will be noted in the background with the various switches, ammeters, voltmeters and rheostat wheels, together with the storage battery end-cell switches, seen in the centre panel. The regulating storage battery plant consists of 275 elements having a maximum charge and discharge rate of 105 amperes.

This accumulator plant was installed when the mountain railroad to Saalburg was started. There are two boosters employed with this plant, each of a capacity of sixty kilowatts. They were provided to balance the drop of pressure on the four-kilometre line from Dornholzhausen to Saalburg.

The present equipment of the engine and generator-room consists of two vertical steam engines of 150 horse-power each, directly coupled with a continuous-current generator of ninety kilowatts capacity, supplying current for lighting and power at 250 volts. Also two vertical steam engines of 300 horse-power capacity, to each of which are coupled one continuous-current Lahmeyer dynamo of ninety kilowatts capacity operating at a potential of 250 volts, and also a traction generator, of the type previously mentioned, of 180 kilowatts capacity and supplying current for the Homburg-Saalburg Mountain Electric Railway at a potential of 600 volts. These last-mentioned units are very compact, thus saving a great deal of room, the total floor space being only twenty-four square metres for each set.

The distribution of current for lighting and power purposes from the Homburg Electricity Works includes the supply of 1,435 incandescent lamps of sixteen candle-power, 180 arc lamps, equivalent to 1,810 incandescent lamps, and fifty-three motors, equivalent to 4,300 sixteen-candle-power lamps, also other apparatus requiring energy to the same extent as

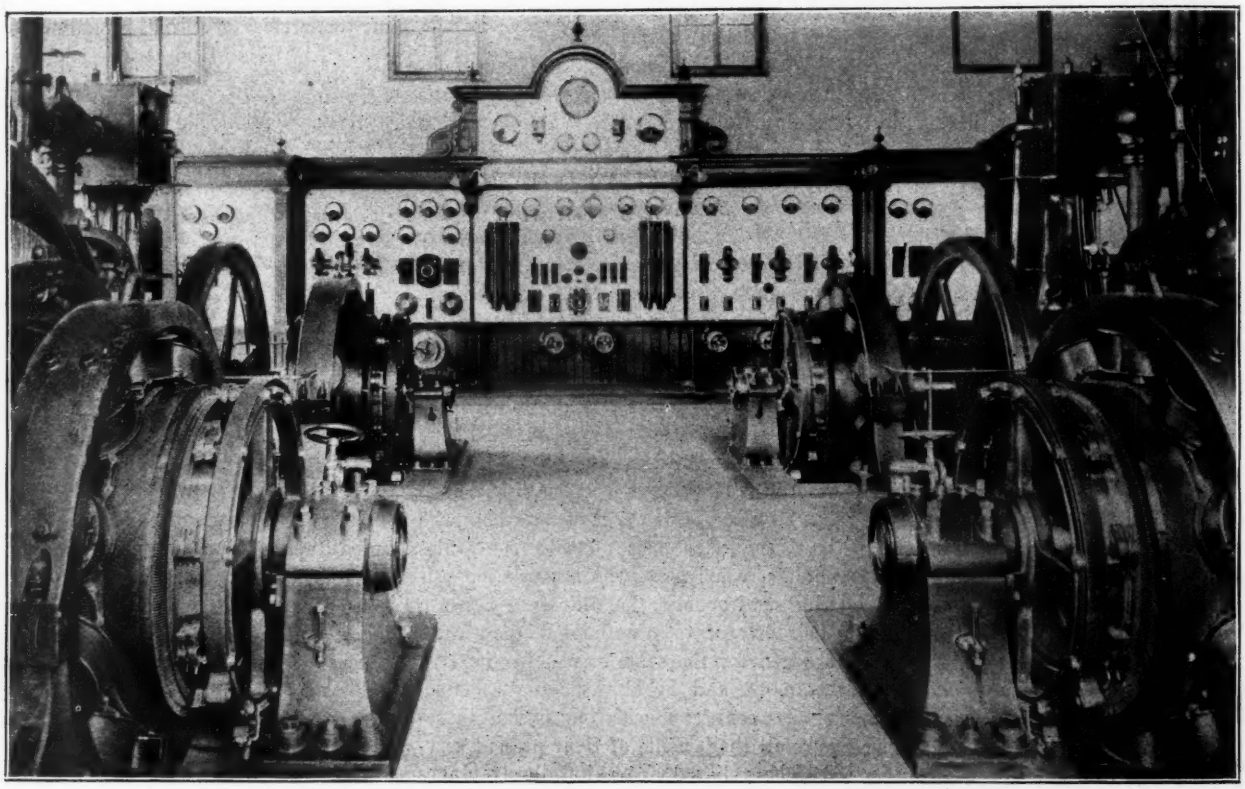


FIG. 1.—GENERAL VIEW OF THE ENGINE-ROOM, CENTRAL POWER STATION, HOMBURG.

950 sixteen-candle-power lamps, so that the total output for commercial light and power of this installation is the equivalent of 21,595 lamps, besides the traction service.

The electric railway installation supplied from the Homburg electrical plant is divided into two sections; first, that portion connecting Homburg with Kirdorf, Dornholzhausen and the Gothic House; second, the Dornholzhausen-Saalburg Mountain Railway, which is four kilometres long and has a gradient of of twenty-seven horse-power capacity. The Saalburg railway station is about 200 metres higher than the station at Dornholzhausen, and the former is located in the centre of a loop of twenty metres radius, which makes a convenient means for turning the cars at the terminal station and doing away with the shunting or switching of the cars and their trailers. The overhead construction is very substantial, iron poles being used, with single overhead trolley wires, the return current being conducted back to the power-house through the track and buried conductors. The cars are well supplied with brakes, consisting of not only a mechanical brake but also an electric short-circuiting brake and a magnetic brake, so that the cars and their trailers may be brought to a standstill even on the steepest grade without difficulty.

The entire electrical system, including the Homburg Electricity Works and the Mountain Railroad, Homburg-Saalburg, has recently become the property of the "Actien-Gesellschaft Elektricitatswerk Homburg" with a capital of 1,250,000 marks.

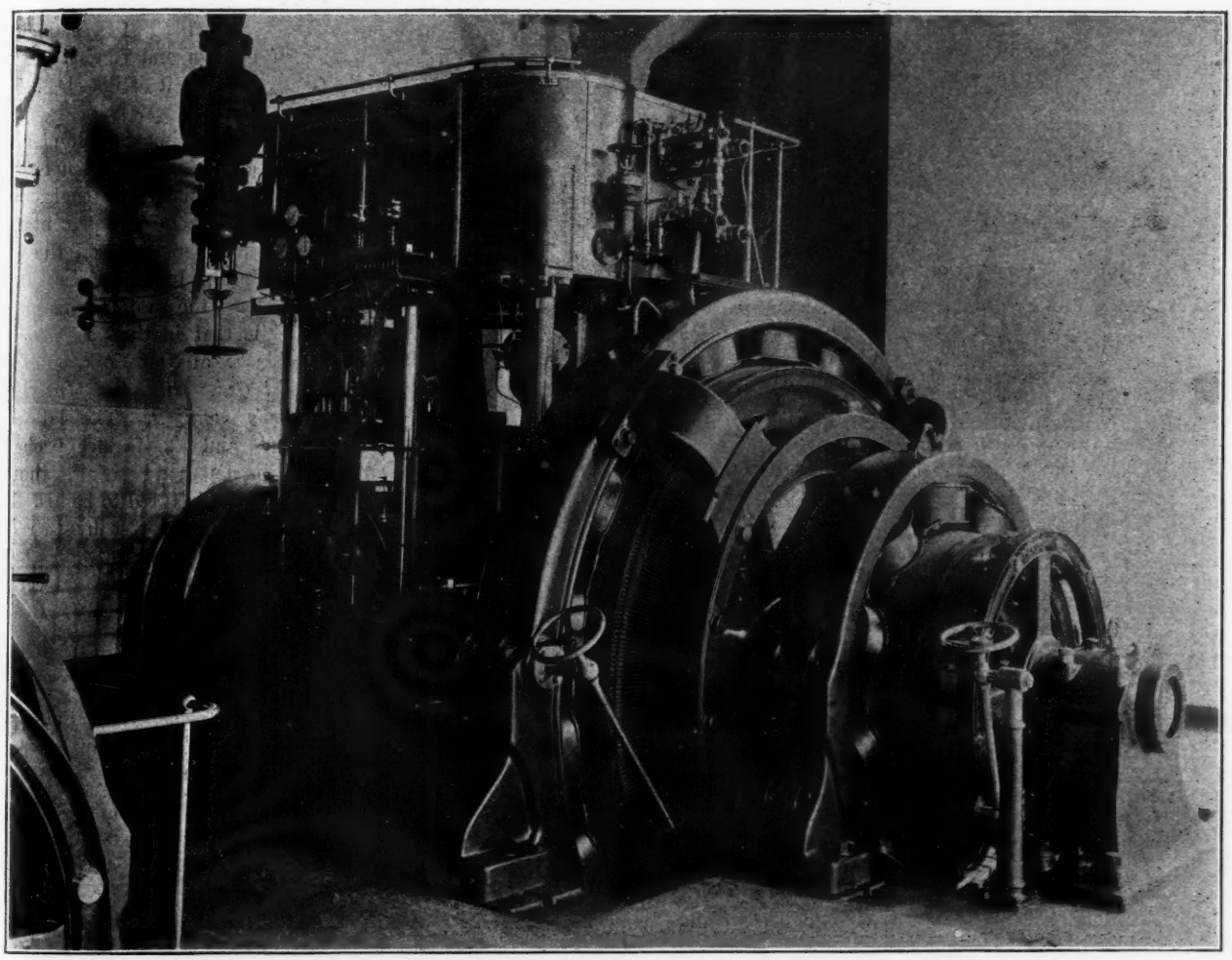


FIG. 2.—DIRECT-CURRENT FLYWHEEL, GENERATOR AND ENGINE SET, CENTRAL STATION, HOMBURG.

1.18 which has to be overcome in a length of two kilometres. The line from Homburg to Dornholzhausen is six and one-half kilometres long and is equipped with seven motor cars and trailers, each of the former being supplied with two twenty-horse-power Lahmeyer railway motors. The gauge of this line is the same as the mountain road from Dornholzhausen to Saalburg, and the cars of the former line are capable of being operated upon the latter line, although the regular cars for the mountain road are heavier, eight of them being equipped with two motors each

Fluorine-Producing Apparatus

Not long discovered, and lately only a scientific curiosity, fluorine has now become the subject of patents. An apparatus by Maurice Meslans, Paris, for the manufacture of this element, has a partition wholly of metal separating the anode and cathode cells, having openings through it below the normal level of the electrolyte. The partition is connected with the anode, and consists of a metal "having the property of forming on its surface a layer of insulating fluoride." So intensely energetic a body as fluorine may find numerous uses, if the expense of the necessary platinum apparatus can be avoided, but it is not clear in the above patent of what other metal the partition, or even the cells, could be constructed.

Consul Donaldson, of Managua, writes that the Nicaraguan Government has signed a contract (dated December 15 last) with Mr. P. W. Chamberlain, an American engineer, to purchase 300 tons of steel rails and other fittings for the Atlantic Railroad, which the latter is constructing.

Some Fine Government Installations.

In the accompanying illustrations are excellently shown two recent installations which have been made for the United States Government, one in the Treasury Department at St. Louis, Mo., and one at Ellis Island, New York.

The plant at St. Louis (Fig. 1) was installed in the basement of the Custom House and Post Office during April and May of 1901 and consists of four direct-coupled engines and generator sets. Two of the engines are 9 inches by 16 inches by 14 inches, tandem-compound, non-condensing McEwen type, and are directly coupled to 75-kilowatt, 250-volt Thompson-Ryan generators. The other two engines are of the 11-inch by 12-inch McEwen simple type, directly coupled with 50-kilowatt, 250-volt Thompson-Ryan generators. The compound engines are rated at 120 horse-power at three-eighths cut-off in a high-pressure cylinder with 125 pounds initial steam pressure. The simple engines are rated at 90 horse-power at one-quarter cut-off with 125 pounds initial steam pressure. This plant furnishes all the current for light and power used in the government offices.

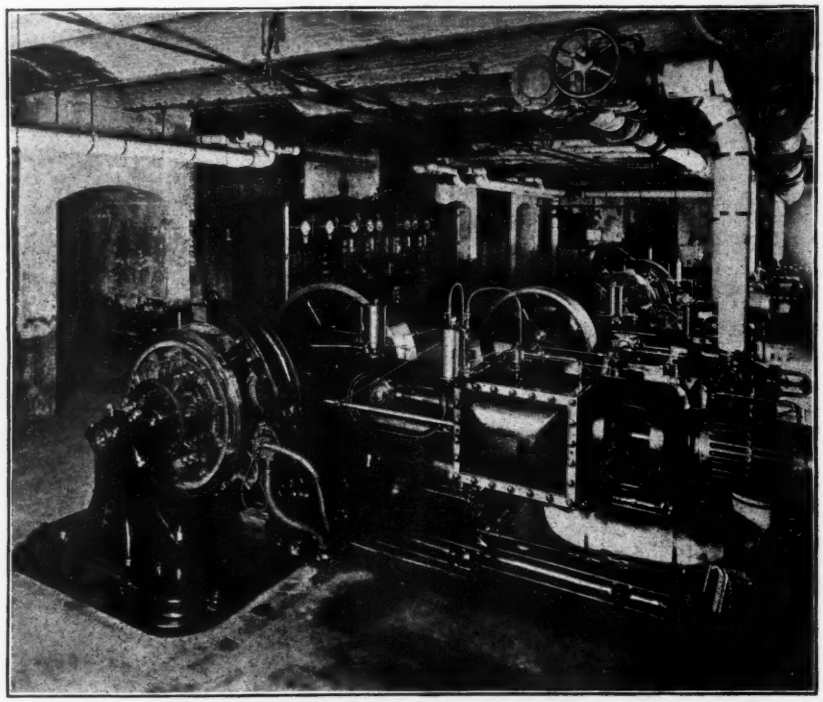


FIG. 1.—THE GENERATING SETS AT THE POST OFFICE AND CUSTOM HOUSE, ST. LOUIS, MO.

The plant at the United States Emigrant Station (Fig. 2) at Ellis Island, New York Harbor, was installed in April, 1901, but was not put in operation until the fall of the same year, owing to the non-completeness of the plant in some other respects. This equipment is made up of five direct-coupled engines and generator sets, all of the engines being of the tandem-compound type. Two engines, with cylinders 11 inches by 18 inches in diameter, at 16-inch stroke, are directly coupled to 100-kilowatt, 250-volt Thompson-Ryan generators. These engines are rated 170 horse-power with 125 pounds initial steam pressure when non-condensing. Another engine, 8 inches by 16 inches, with 14-inch stroke, is directly coupled to 75-kilowatt, 250-volt Thompson-Ryan generators, and is rated at 125 horse-power, with 125 pounds initial steam pressure and 26-inch vacuum. The fifth engine, a 9-inch by 16-inch, 14-inch stroke, is directly coupled with a 75-kilowatt, 250-volt Thompson-Ryan generator and is rated at 125 horse-power with 125 pounds initial steam pressure and no vacuum. This plant is used for lighting the immense buildings and houses of the Emigrant Station and for a number of other motors used in various places on the island.

The specifications as to economies for the engines and the efficiencies for the generators were very severe and before shipment of any part of the contract from the factory a thorough test was conducted by the United States Government engineers to determine that the requirements of the contracts were adhered to.

Both of these plants were installed by the Ridgway Dynamo and Engine Company, Ridgway, Pa.

THE AUTOGRAPH OF DR. WILLIAM GILBERT.*

BY DR. SILVANUS P. THOMPSON, F. R. S.

Until quite recently not one example of the handwriting of the father of the science of electricity, Dr. William Gilbert, was known to exist. The manuscript of his famous "De Magnete," printed in 1600, has long ago perished. All his own collection of manuscripts, maps, minerals and magnets, together with his correspondence with the learned men of Europe, was burned in the great fire of 1666. The very spelling of his name was a matter of dispute and conjecture, for while many wrote it Gilberd, others spelled it Gilbert. It was printed as Gilbert in his own lifetime in Blundevile's "Theoriques of the Seven Planets," in 1602. Two at least of the copies now extant of "De Magnete" are presentation copies and bear inscriptions on the title page. That in the library of the Royal Institution has the words *Ex dono auctoris,* while that in the possession of Mr. C. L. Clarke, of New York, bears the record *Dedit Guil: Gilbertus. Jo: Sherwood propriis manibus.* The latter is certainly not, and the former probably not, in Gilbert's handwriting, though both have been conjectured to be his. The doubt has been set at rest by two discoveries.

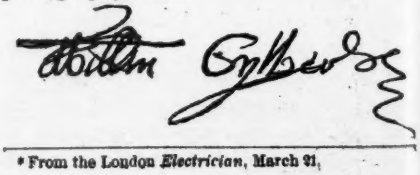
The first of these is a medical certificate preserved in His Majesty's Record Office in London among the state papers. It runs thus:

To the Right honourable Sir Francis Walsingham, Knight, Principal Secretary to her Majesty.

Pleaseth it yo^{r} Honno^{r} to be advertised That whereas wee are required by this Gent Mr. Hungait, to delyver our opinions as concerning the cause of his desire to travyll beyonde the seas, True it is that we have advised him thereunto as thinkinge his being for some tyme in hotte and drye Countryes will muche staye the wayt and fflux of his cold and Rhumatike diseases, which by longe observation, both he and wee have founde, to abounde most when the weather is Colde and Intemperate, And thus most humblye taking our leaves we comit yo^{r} Honno^{r} to the benediction of the Almightie, London this first of Februarye 1584.

Yo^{r} Honnor^{s} most
redely to comannde
WILLM GYLBERDE.
LANCELOT BROWNE.

This signature has been reproduced by photography, thus:



* From the London *Electrician*, March 21.

Gilbert at that date was not yet appointed physician to Queen Elizabeth nor president of the Royal College of Physicians. The Lancelot Browne, who also signed the certificate, succeeded Gilbert in the latter office in 1603.

The second discovery has been made by Mr. R. F. Scott, Senior Bursar of St. John's College, Cambridge, which office was held by Gilbert himself in 1570. The books of St. John's College contain one or two entries in his hand on his admission to a fellowship and some college offices. Here he signs his name as Gylberd.

I have also searched Somerset House for the signature to his will, which was supposed to be an original document. It proves, however, to be only a copy, and in it the name is spelled both Gilberd and Gilbert.

As Gilbert had correspondence with Sarpi and Sagredo, and other learned men on the Continent of Europe, it is probable that letters of his may exist in the libraries of Continental universities. Enquiries lasting over fifteen years have, however, failed to elicit any evidence of their existence.

The American Street Railway Association.

The executive committee is making every effort to make the exposition which will be held at the Light Guard Armory in conjunction with the twenty-first annual convention of the American Street Railway Association in Detroit, Mich., on Wednesday, Thursday and Friday, October 8, 9 and 10, 1902, very successful, as the exhibits and displays of the supply men will be a most important part of the convention.

The convention will be held in the armory, thus ensuring the attention of all delegates and visitors to the exhibits. The income from the sale of space will go to the American Street Railway Association. Applications for space should be made to John H. Fry, Detroit United Railway, No. 12 Woodward avenue, Detroit, Mich., chairman Committee on Exhibits, and it is earnestly requested that all exhibits shall be in place and all work finished by Tuesday evening, October 7, which is the evening prior to the opening of the convention. Space should be applied for by August 1, and assignments will be made as promptly as possible and exhibitors notified of their location. Exhibits of like character will be grouped together and space will be assigned in the order of application.

Thursday, the ninth, has been set apart by the executive committee for the examination of exhibits. No sessions of the association will be held on that day, and no entertainments of any kind will be given by the local committee. The headquarters of the association will be at the Cadillac Hotel. The annual dinner will be held Friday, October 10. The railroads will sell tickets on the certificate plan, and it is suggested that certificates be delivered to the clerk the first day of the convention, when registering. They will be signed, vised and ready on Thursday, October 9.

The executive committee has found the Detroit friends so enthusiastic as to the coming meeting, and so hospitable in their greeting that success is assured. The location is central and easily accessible, and from enquiries and information already received an unusually large attendance seems guaranteed.

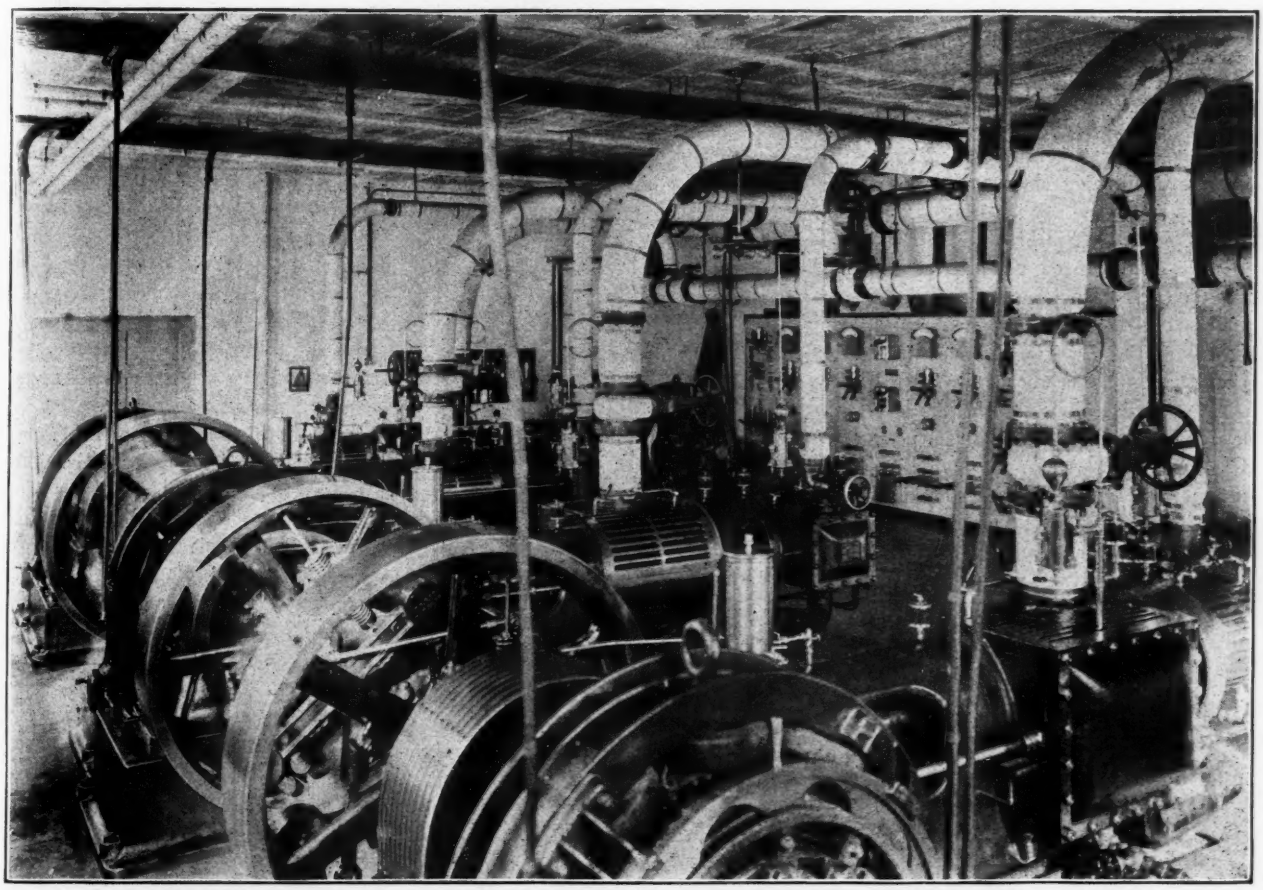


FIG. 2.—THE GENERATING SETS AT THE ELLIS ISLAND EMIGRANT STATION, NEW YORK HARBOR.

The Electrically Driven Equipment of a Modern Electrotyping Plant.

Probably one of the most useful adaptations of small motors for driving machinery in which almost every range of service, from light strains with great speed to comparatively few revolutions of great pressure, is exemplified in the application of this form of motive power to the devices which are used in the electrotyping art. While the use of depositing dynamos is not a new story, the application of motors for driving the working mechanisms of electrotypers' machinery is of comparatively recent origin.

In an electrotyping establishment the work to be done presents considerations which place it apart from most factory regulations. A large portion of the machinery is worked only intermittently, at times running for several days continuously and then being shut down for as many days at a time. With the old system of belts and shafting it was the usual practice to simply throw the belt on to a dead pulley and still keep up as large a pressure of horse-power in the engine-room, with no useful performance of work, as when the plant was working to its full capacity. The machines used in this service are of a number of types, and a plant of any considerable size once required a great amount of shafting, counter-shafting, belts and pulleys. The saving in this equipment of such a plant by using directly coupled electric motors is considerable.

The well-known publishers, Street & Smith, of New York city, have recently had installed a complete equipment of electrically driven electrotyping apparatus. This plant was supplied by the F. Wesel Manufacturing Company, of New York city, the motors all being of the Lundell type. With the exception of a plant installed by the printing department of the New York Life Insurance Company, under the supervision of its superintendent, Mr. W. H. Van Wart, which, it is believed, was the first electrically driven electrotyping plant ever installed, the Street & Smith plant is the first in New York city. An exception might be made of a special electrotyping plant operated by the New York *Herald*, but the *Herald* plant has a limited number of machines which are used for producing a special class of work. Only a few of the different classes of machines which are operated by the electric motors in the Street & Smith plant are illustrated. These are selected because in each instance a severe and exacting service is required of the motive power connected with it.

Fig. 1 is an electrotypers' toggle-power moulding press. This is operated by a two-horse-power compound-wound motor. A specially designed device is mounted at a convenient place for the moulder to reach, which automatically reverses the motor when the necessary depth of impression has been reached, as indicated on the pressure gauge of the machine. The motor on this machine is required to start, gain speed very rapidly, reach a very high

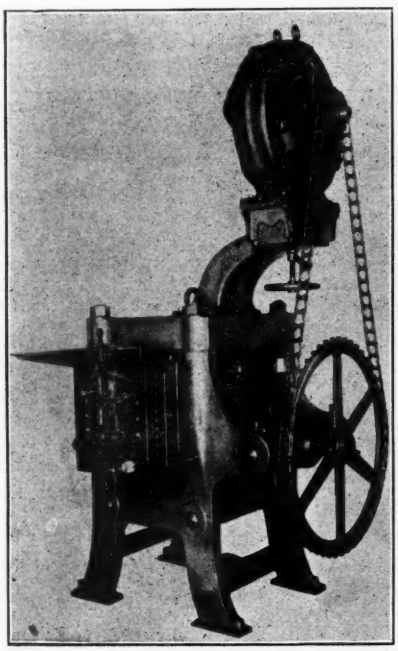


FIG. 1.—TOGGLE-POWER MOULDING PRESS.

condition of load, be reversed and come to a stop in a very short period. There is also an automatic device which prevents the operator from running the motor in the wrong direction. The whole forms one of the most ingenious applications that has been used in this class of machinery. At the moment when the maximum pressure is exerted by this press it has been found by tests that a load of sixteen horse-power is developed, but this is maintained for only a few seconds. Tests on similar machines, which have been installed and driven by this same class of motor, used by Harper & Brothers, New York, and the *Colliery Engineer* Company, of Scranton, Pa., have shown this to be the case with practically every application of power.

Fig. 2 represents a screw-driven power metal-shaving machine for shaving the backs of plates smoothly to the gauged height to print from. As a plant of this description performs work which ranges from very small to very large surfaces, it is necessary to have a considerable range of operation for the planing device. In this machine the motor is furnished with an automatic reversing rheostat, and the operator having started the machine does not touch the starting box until the whole operation of shaving has been completed. An interesting feature in connection with this machine is that the shaving head may be automatically reversed at any point on the line of travel, so that while a full-sized plate is to be shaved, requiring the full travel of the planing device, a plate one-half or one-quarter the size may be worked with great convenience. When machines of this class are driven by a belt the operator has to reverse the machine by a belt-shifter. This is one of the most satisfactory uses in connection with electrotyping machinery to which the electric motor has been applied.

An ideal application of a motor is found in connection with the routing machine, which is shown in Fig. 3. The armature of the motor is specially wound on a shaft which is coupled to the base of the pedestal, as is excellently shown in the illustration. The starting boxes and speed controllers on this machine are operated entirely by a treadle. The operation of this machine requires that both hands be in constant and careful service, and the starting, stopping and regulating of the speed must be done by the foot. This is a very delicate machine, developing a speed by a succession of cone gear-

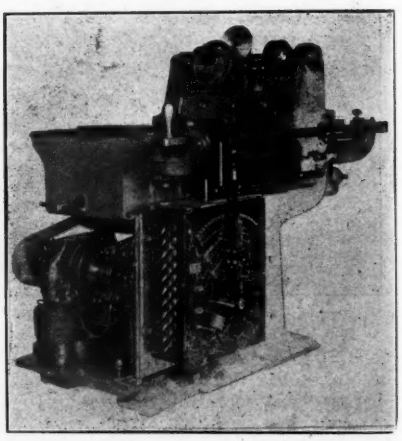


FIG. 2.—SCREW-DRIVEN METAL-SHAVING MACHINE.

ings, on the cutting tool of from 14,000 to 20,000 revolutions per minute, routing copper and zinc, the cutting tools ranging from one-thirty-second of an inch to three-quarters of an inch.

Fig. 4 shows a small-size roughing or planing machine. This is another very interesting application of a motor. As is excellently shown in the engraving the motor on one side is used to drive a belt

and on the other a pinion makes contact with a gear-wheel, the requirements of this machine being such that two widely different variations of speed be secured. A powerful arm which is connected to the

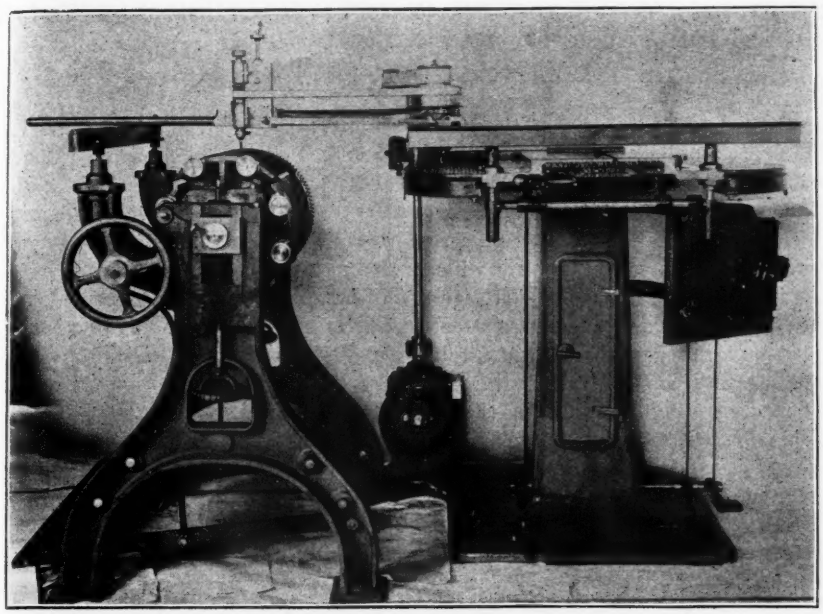


FIG. 3.—SHOWING ARMATURE SHAFT OF MOTOR COUPLED TO DRIVING PEDESTAL OF ROUTING MACHINE.

rim of a large wheel which is fastened on the same shaft as the pulley driven by the belt side is caused to rapidly travel across the back of the plate carrying the cutting tool which skips off or grooves the plate, the planing operation being finished by the machine illustrated in Fig. 2. At the same time and in step with the movement which carries the skip or cutting tool back and forth across the plate, a lateral movement is effected by the bed of the metal which carries the plate a point further at the end of each travel of the skip, so that a new surface is presented to each contact with the cutting tool. The movement of the cutting tool is very rapid, the lateral movement of the bed being comparatively slow.

In this plant there are in all thirty-two motors, ranging from a seven and one-half horse-power, which operates a four to six-volt No. 4 World Depositing Dynamo, down to a one-half horse-power motor which operates a jig-saw, drill and saw sharpener in one combination. This is a very ingenious and interesting application.

It is now five years since the F. Wesel Manufacturing Company installed its first electrotyping plant operated by electric motors. This plant was purchased by the Galvanoplastik Company, of Berlin, and is the largest electrotyping plant in the world. Since that time several hundreds of motors in connection with electrotyping machinery have been installed in plants in different parts of the United States and in the far countries, in China and in the Philippines. It is a peculiar fact that while there have been complaints in regard to the electrotyping machinery, there

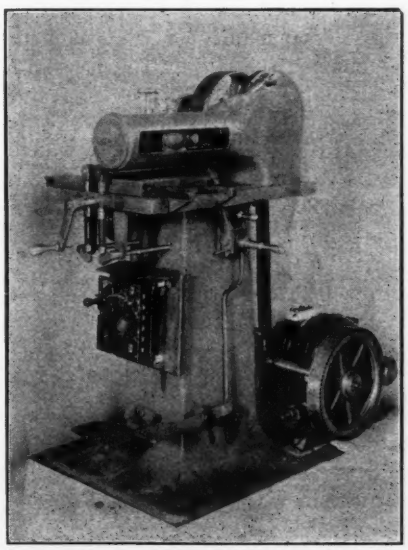


FIG. 4.—SHOWING PINION AND BELT CONNECTION ON SMALL SIZE ROUGHING MACHINE.

has never been registered a single claim for lack of efficiency or complaint in regard to the motors. This experience is particularly gratifying in regard to the reliability of electric motors, as it must be considered that these motors are placed in almost every instance under the care of people who are almost wholly, if not totally, inexperienced in the use of electric machinery of any description.

Another disadvantage which is found in applying electric motors for this class of service is that in an electrotyping plant graphite is used in great abundance, the atmosphere near the machine being filled at all times by a fine graphite dust. Then again there is constantly during the operation of almost every type of machine designed for electrotyping work a shower of small pieces of copper and zinc and bits of wood flying about. It is always necessary in installing motors for this class of work to use an enclosed or semi-enclosed type, and sometimes it is necessary to enclose the whole working unit in special boxes.

Electrical Convention in the South.

The Southwestern Gas, Electric and Street Railway Association will hold its fourth annual meeting in the city of San Antonio, Tex., April 18 to 21 inclusive. Both the business and social sides of the meeting are being carefully looked after, and San Antonio, with its known hospitality, and with Colonel E. H. Jenkins as host, will make this meeting of the association a very gratifying success. A good business programme has been arranged, and the entertainment features will embrace the most enjoyable which have yet been introduced. Special railroad rates have been secured to San Antonio, all roads selling round-trip tickets on the seventeenth for trains arriving at San Antonio on the morning of the eighteenth, at the rate of one fare plus ten per cent. The secretary is Mr. T. H. Stuart.

Electrolytic Works in Italy.

A company with a capital of about £44,000 has just been formed at Milan for the electrolytic manufacture of caustic soda and of calcium chloride. These two products have up to the present been imported into Italy. The works of the new company will be situated at Varallo, where some 600 horse-power will be obtained from the River Sesia. The company expects with 350 working days of twenty-four hours to produce some 2,359 tons of calcium chloride solution and 2,880 tons of caustic soda solution. This will require about 1,806 tons of sodium chloride and 1,216 tons of quicklime. The estimate of the income and cost shows an annual profit of fourteen per cent. It has not been stated whether the water power is subject to an annual rental.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE.

GIVING CONCISELY THE SUBSTANCE OF IMPORTANT PAPERS IN THE SCIENTIFIC, ELECTRICAL AND ENGINEERING PRESS OF THE WORLD.

THE following paragraphs give, in condensed form, the substance of the principal articles appearing in the engineering and scientific press of this and other countries. They represent simply the gist of the article in each case, having been compiled and abstracted from the original sources, to which credit is given. The journals read for the preparation of these abstracts are the principal publications in the English, French, German, Danish, Spanish, Italian and Portuguese languages. These reviews of the technical press will appear regularly in the ELECTRICAL REVIEW.

The Industries of Sweden.

Statistics for the year 1900, published by the Swedish College of Commerce, show the value of the produce of Swedish industry for that year, not including mining, to have been $290,000,000. Of this amount engineering and machinery works produced $14,500,000 and electrical works $2,500,000. The profits upon which taxes are collected, which are probably less than the total net profits, amounted to over seven per cent of the value of the output. —*Engineering* (London), March 14.

Norwegian Expedition to the Magnetic Pole.

During the spring of 1903 Mr. Roald Amundsen will lead an expedition from Norway to the west coast of Boothia Felix in an attempt to relocate the north magnetic pole. His expedition will be equipped for four years and will carry elaborate magnetic instruments, built under the superintendency of Professors Neumayer, of the German Navy, and Chree, of the Kew Observatory. Most interesting and valuable results are expected to follow.—*Terrestrial Magnetism* (Cincinnati), March.

The Iron Arc in Therapeutics.

MM. A. Broca and A. Chatin have experimented on the arc between iron electrodes for use in photo-therapeutics. The peculiarity of this arc is that the crater is not very luminous and the chief luminosity comes from the arc itself. The actinic rays are of great intensity as compared with the heat rays. This property makes it possible to use the arc within four inches of the diseased surface, even when the current is as heavy as twenty amperes at thirty-five volts, without interposing any cooling medium. In cases of lupus an exposure of fifteen minutes produced a marked effect. Twenty-four hours after exposure the healthy skin was found not to have been attacked, but the diseased parts were found profoundly altered and benefited.—*Comptes Rendus* (Paris), March 3.

The Influence of the Moon on the Aurora and Thunder-Storms.

An interesting abstract from Danish papers of the work of Professors Ekholm and Arrhenius shows the existence of a monthly variation in the fall of atmospheric potential according to the moon's revolution period. The aurora appears to have a well-defined periodic variation with a maximum at new moon and a minimum at full moon. The material for the investigation consisted of observations on the aurora in Sweden, Norway, Iceland, Greenland, the north of Canada and in the southern hemisphere. Elaborate calculations were made to eliminate the effect of the moon's light. The result showed a pronounced variation of the aurora with the declination of the moon in the northern hemisphere.—*Terrestrial Magnetism* (Cincinnati), March.

Earth Currents.

Herr E. Jar describes the results of a long series of researches upon telluric currents by means of electrodes buried in the ground and the conclusion reached from them. With metallic plates of the same metal he has concluded that two plates of equal dimensions, placed in the magnetic meridian so that the north plate is the deeper of the two, will show a difference in potential that is constant for such a condition. If the southward plate is the deeper the direction of the current is inverted. To give an idea of the magnitude of the phenomena observed, the author states that for distances of about 300 metres, plates of one by two metres in size buried at a depth of from one to five metres showed a variation in tension of from one to fifty millivolts. The intensity of the current in the conductor connecting the two is exceedingly variable, and observations on it can only be made at exceptional moments.—*Elektrotechnische Zeitschrift* (Berlin), March 6.

Crystallization under Electrostatic Stress.

Interesting negative results have been obtained by Mr. P. R. Heyl in experiments to discover the effect of an electrostatic field upon the formation of crystals. A shallow glass dish with a flat bottom was placed upon a sheet of tin-foil. Within this raised, about 5 mm. from the bottom, was a similar but smaller dish. This rested on a glass rod laid in the larger dish. The inside of the bottom of the smaller dish was coated with tin-foil. The two tin-foil sheets were connected to the terminals of an induction coil or of a powerful influence machine. The solution under experiment was poured between the dishes after the electrostatic stress had been started. Two solutions were used, sulphur in carbon bisulphide and a hot saturated solution of mercuric iodide in alcohol. No change in the angles or arrangement of the crystals was noticed, and the author concluded that the molecular forces in the electrostatic field were not comparable with those called into play by crystalline attraction. —*Physical Review* (London), February.

Temperature Variation of Electrical Resistance.

A paper by Mr. W. Williams before the Physical Society brings qut some interesting results concerning the temperature variation of electrical resistance of pure metals and alloys. An attempt is made to correlate the periodic variation which pure metals exhibit with regard to their atomic weights, chemical valencies, melting points and electrical resistance. If m is the chemical valency, V the atomic

volume, θ the absolute temperature, T the absolute melting point, and C, or $V\frac{1}{3}$ a +, the constant of Picket's law, then $\sigma \propto \frac{m V \theta}{c T}$ where σ is the specific resistance at 0° C. This relation holds good for most of the metals, but fails for gold, tin, aluminum and indium, and also for the metals of the iron group. The temperature resistance coefficients of pure metals are not precisely equal to $\frac{1}{273}$ and the author deduces an expression for the change of resistance with temperature which holds approximately for many metals. Simple expressions are obtained also for the average increase per degree of the specific heat of metals and for the ratio between the specific resistances of solid and liquid metals at the temperature of melting.—Paper before the Physical Society (London), March 14.

Condensers in Practical Work.

An interesting discussion on the subject of condensers for reducing the bad power-factor of long-transmission lines forms the subject of an editorial article in an Italian contemporary. The results of experiments on 3,300-volt service installations at Paris were utterly to destroy condensers that could carry 8,000 volts mean effective pressure in the laboratory. The conclusion is reached that the price of condensers should not be greater than $10 per kilowatt capacity. Applying the author's conclusion to a transmission line between Bussoleno and Turin, in Italy, he shows that a condenser of 17.4 microfarads capacity would be enabled on this line to save 55.5 kilowatts of energy. The conclusion that he arrives at finally is that, under ordinary circumstances, the energy saved as effective and disposable power will not cost more than $4 per year per kilowatt. Whether or not the introduction of condensers on transmission lines for this purpose will not result in resonance and other effects producing a bad effect on cables and leading to the destruction of condensers can only be determined by experiment. No mention is made of dynamic conductors or of the use of synchronous machines running over-excited.—*L'Elettricità* (Milan), March 16.

The New Jungfrau Locomotive.

The design of the new electric locomotive for the Jungfrau Railway differs considerably from that of the locomotives first employed. The new machine is fitted with two six-pole three-phase motors, each weighing 4,620 pounds, which are supplied with current at from 450 to 550 volts at thirty-eight cycles. Each machine runs at 750 revolutions per minute and develops 120 horse-power. After three hours' work at full load the temperature rises only seventy-seven degrees Fahrenheit above that of the surrounding air. Current taken when running light is twenty-five amperes at 500 volts. The maximum current is 800 amperes at the same pressure. The energy developed is transmitted from a worm gear through a pinion which runs in a counter gear upon the driving axle. The ratio of gearing is such that at normal speed the locomotive travels 4.8 miles per hour. To one of the motors is coupled direct a small six-pole direct-current dynamo developing 150 amperes at twenty-five volts. The current produced is sent through the field-winding of the main motors when descending the incline, the motors thus becoming ordinary three-phase generators. The locomotive was built by the Schweizerische Lokomotiv und Maschinenfabrik, of Winterthur, Switzerland.—*Mechanical Engineer* (London), March 22.

The British National Physical Laboratory.

A description of the new Physical Laboratory at Bushy House, England, is given in the British electrical papers. Practically the whole of the ground floor and the basements of the large and substantial building have been equipped as laboratories, while the numerous rooms enable the various classes of work to be kept distinct. A power-house and engineering laboratory have been erected in a group of buildings about 100 yards from the main buildings. Here will be made strength of materials tests and, probably, commercial tests of magnetic properties of iron. The power and light equipment of the institution is obtained from a sixty-kilowatt steam turbine unit and a large battery of accumulators has been installed. A gas engine coupled to a Parker dynamo is used as a reserve plant. The storage batteries are in three groups, one in the power-house, one in the main building, for testing the circuits, and a smaller battery in the laboratory devoted to thermometry, which is used for heating electric heaters and furnaces. The switchboard combinations for the batteries are very elaborate, giving a large number of different arrangements. In the main building there are two distinct systems of wiring. The electric light circuits are run in concentric cables so as to avoid any interference with testing instruments. The other wiring system is for test purposes, all of these wires being of bare copper supported in sight on porcelain insulators. In this laboratory are preserved the historical standards of the British association. An elaborate Lorenz apparatus is about to be erected. The thermometry laboratory is extremely well fitted for its purpose. Electric furnaces or ovens are employed for high temperatures up to 1,400 degrees centigrade. A photometric laboratory will be equipped in the future.—*The Electrical Engineer* (London), March 21.

Direct-Current Power Transmission from St. Maurice to Lausanne.

Signor E. Bignami describes an interesting plant on the Thury system which has been put in between St. Maurice and Lausanne, in Switzerland. The municipality of Lausanne owns a water-power of some ten to fifteen thousand horse-power, fifty-six kilometres (34.7 miles) distant from the city and has installed a plant on the direct-current Thury system to utilize it. Estimates showed that the saving on the total first cost of the plant over a three-phase installation would be 640,000 francs. The generating station contains at present five 1,000-horse-power turbines, each driving two dynamos giving a constant current of 150 amperes with a maximum pressure of 4,600 volts. At full load the total output of the present plant is 150 amperes at 23,000 volts. The switchboard is of extreme simplicity, consisting for the most part of short-circuiting switches by which the machines are cut in or out. The transmission line is put up on double bell insulators guaranteed at 50,000 volts. One 400-horse-power motor is cut into the line in the middle of its length. At the receiving station motors of 400 horse-power are used, the installation at present comprising five. These machines take 150 amperes and up to 2,150 volts. The speed regulation of the motors is accomplished by shunting their magnetic fields and adjusting their brushes. Three of these motors directly drive three-phase alternators for the distribution of electric power and light in the city of Lausanne and its suburbs. Another one of these motors drives dynamos giving power for the electric railway system of the town. A large number of lightning arresters of the usual "horn" type are used on the line. The success of the first installation is so marked that additional apparatus will be put down immediately.—*L'Elettricità* (Milan), March 16.

The American Electrochemical Society.

The Organization Meeting and First General Meeting of the New Body for the Advancement of Electrochemical Engineering, Research and Science, at Philadelphia.

AT PHILADELPHIA on April 3, 4 and 5, 1902, there was inaugurated the American Electrochemical Society which bids fair to become one of the most important scientific and engineering societies in the country.

The movement for the organization of the society grew out of the interest in electrochemical subjects taken by a number of gentlemen residing in and about Philadelphia, and who considered that in time there might be formed, around the semi-social gatherings in which they took part, the nucleus of an important society for advancing the interests of electrochemists. A call for a formation meeting was issued some weeks ago and mailed to the members of the American Institute of Electrical Engineers, and of the American Chemical Society, and to other persons who were thought likely to be interested in the formation of the new body. The responses received were numerous and satisfactory. It was determined that the first meeting should be held in Philadelphia, on the evening of April 3, and that such members as chose to meet earlier on that day should be conducted to various points of professional and other interest in the city.

On the afternoon of April 3 there assembled at the Colonnade Hotel about seventy-five gentlemen who desired to become members. These were escorted to the works of Harrison Brothers & Company, Incorporated, a concern which is a large manufacturer of chemicals and paints. Here there was shown some exceedingly interesting operations of an electrochemical character which are carried out upon the designs of Mr. J. D. Darling. The process of manufacturing nitric acid and metallic sodium from the electrolysis of fused sodium nitrate was shown in operation. The cells used for this reduction consist of a cylindrical chamber in which is a porous vessel made of wire gauze and a magnesia cement, the cathode being inserted in this inner compartment. Both anode and cathode are of iron. Current at a pressure of fourteen volts is used in the furnaces, the sodium nitrate being fused in crucibles and poured in in a liquid condition. Metallic sodium gathers in the inner compartment and is taken out from time to time by means of a spoon, the melted metal being poured into cans containing paraffin. It finds its way to the bottom of the melted paraffin which protects it from oxidation. The nitrous fumes rising at the anode are piped to a system of clay tanks and vessels where they are converted into nitric acid in the usual way. At the same works Mr. Darling is also manufacturing cyanide of sodium by means of a process of which the details are not made public. Here also were seen a number of interesting primary batteries, the cells giving an electro-motive force of two and one-half volts each. These cells are constructed of a cylinder of amalgamated zinc and the positive plate of lead peroxide supported upon a lead grid. The electrolyte is diluted sulphuric acid. In the evening a dinner was given by the reception committee at the Manufacturers' Club, after which the formal meeting for organization was held.

Professor J. W. Richards, of Lehigh University, was made temporary chairman and Mr. Carl Hering temporary secretary. The report of the committee of the preliminary organization, which had sent out the announcements and invitations, showed that 337 persons had applied for membership, these representing thirty-six states and eight foreign countries, including Australia. New York, Pennsylvania and Massachusetts had the largest representation, in the order given. The first business to be considered was the name of the society. There was a short and somewhat amusing debate as to whether the word "electrochemical" should be spelled with or without a hyphen, but by a somewhat narrow majority it was decided finally that the name of the society should be "American Electrochemical Society." The election of officers was then proceeded with and the name of Professor J. W. Richards was placed in nomination for the first president of the society by Mr. H. B. Coho. Professor Richards was elected by acclamation and, after a short speech of thanks, he took the chair as its permanent occupant. A committee of nominations was then appointed to select nominees for vice-presidents, a board of managers, a secretary and a treasurer. The nominations of this committee were elected, as follows: Dr. C. E. Doremus, New York; Professor W. D. Bancroft, Ithaca, N. Y.; Professor H. S. Carhart, Ann Harbor, Mich.; Mr. C. M. Hall, Niagara Falls; Professor Louis Kahlenberg, Madison, Wis.; Mr. W. R. Whitney, Schenectady, N. Y.

Managers, Messrs. Carl Hering, Philadelphia; E. G. Acheson, Niagara Falls; Dr. E. F. Roeber, Philadelphia; Mr. C. O. Mailloux, New York; Mr. Edward Weston, Newark, N. J.; Dr. Samuel Sheldon, Brooklyn, N. Y.; Mr. W. D. Weaver, New York, and Lieutenant-Colonel Samuel Reber, U. S. A., Washington, D. C.

Mr. C. J. Reed, of Philadelphia, was chosen secretary and Mr. Pedro G. Salom, of Philadelphia, treasurer.

The constitution was then taken up and the draft of the proposed instrument was read and discussed at some length. It was finally decided that the meeting should express its view as to the plan and scope of each section, leaving the question of the language of the constitution to the board of directors, consisting of all of the officers and managers named above. In general the constitution resembles that of the American Institute of Electrical Engineers, except that there is, for the present, only one class of members. Dues are fixed at five dollars per year. The questions of meetings, etc., are left to be determined by the board of directors of which an executive committee will bear the brunt of the work. The meeting referred the question of printing the transactions of this occasion to the board of directors with a recommendation that they be printed.

The two sessions of the meetings for the reading and discussion of papers were held in class-rooms in the chemical laboratory of the University of Pennsylvania through the courtesy of that institution. The first meeting was held on Friday, April 4.

President J. W. Richards presented a paper entitled "A University Course in Electrochemistry." In this paper he described at length the courses and methods of study which, in his opinion, constitute an ideal course for an electrochemical student. The paper was discussed by Professors Bancroft and Burgess, and was well received.

Mr. Clarence L. Collins, 2d, of Niagara Falls, read an interesting paper on "Electrodes," and exhibited a number of specimens of graphite electrodes manufactured by the Acheson process. The discussion of Mr. Collins's paper was very interesting and was generally partici-

pated in, a number of questions being asked and answered concerning the durability and operation of graphite electrodes under various conditions.

A highly technical paper entitled "A Note on the Gladstone-Tribe Couple" was presented by Professor W. D. Bancroft. This couple consists of a zinc strip upon which is electrolytically deposited a film of copper, and such strips have been found reagents of considerable value in synthetic chemistry.

The next paper presented was one that created no small degree of comment. It was by Mr. C. J. Reed, of Philadelphia, and was entitled "The Nascent State." Mr. Reed vigorously attacked the ancient dogma of the nascent state and elaborated his reasons for believing that what chemists had hitherto conceived to be some peculiarity of substances newly breaking away from the bonds that had held them in chemical union was an electrochemical phenomenon. These were set forth with great clearness and at some length. The discussion of Mr. Reed's paper was long and general, as the question is one of the deepest interest and underlies some of the fundamental structure of chemical theory.

Dr. P. G. Salom then read an instructive paper describing a process for the electrolytic reduction of lead by a method as now practised at Niagara Falls. He also exhibited samples of the lead produced and of various salts and pigments made from it.

Mr. Titus Ulke then read an important paper entitled "The Refining of the Composite Metals," in which he set forth at length a new method for the electrolytic separation of nickel and copper from matter containing these metals. After this paper an adjournment was taken to Houston Hall, the beautiful students' club-house of the University of Pennsylvania, where the university authorities had provided a luncheon for the society.

Immediately after luncheon the afternoon session was called and was opened by a paper by Professor H. S. Carhart, entitled "A Novel Concentration Cell." This paper proved to be one of the most interesting that had been presented. In experimenting with concentration cells, Professor Carhart had discovered that a cell using nickel electrodes in a solution of nickel sulphate gave an electro-motive force opposite to that which the currently believed theory indicates. In seeking an explanation for this curious phenomena, he had concluded that the potential difference generated in such cells is electrothermal in character. The discussion which followed was lively and interesting, since these phenomena are hard to reconcile with the widely accepted theory of the electrolytic dissociation.

Mr. Edward H. Taylor described briefly and very interestingly his new method of manufacturing carbon bisulphide in the electric furnace. This process was described and illustrated in the ELECTRICAL REVIEW for February 1, 1902. The paper was received with hearty applause.

Other papers read at this session and also on the following day were as follows:

Professor Louis Kahlenberg, Ph. D., University of Wisconsin, Madison, Wis.: "Current Electrochemical Theories."

JOSEPH WILLIAM RICHARDS, PRESIDENT OF THE AMERICAN ELECTROCHEMICAL SOCIETY.

Joseph William Richards was born in Oldbury, England, July 29, 1864. Coming to this country at an early age, he was educated in the Philadelphia High School, and graduated subsequently from the Lehigh University, chemical course. He studied in Heidelberg and Freiberg, Germany, and now holds the degree of A. M. and Ph. D. He was a member of the United States Assay Commission in 1897, was made president of the chemical section of the Franklin Institute in the same year, and was the representative of that Institute to the International Geological Congress in Russia in 1897. He has written many contributions to the technical and scientific press, and has enjoyed a large practice as a legal expert in metallurgical cases. Professor Richards at present fills the chair of Metallurgy and Mineralogy in Lehigh University.

Herbert H. Dow, Midland, Mich.: "A Zinc-Bromine Storage Battery."

N. S. Keith, Ph. D., New York city: "Continuous Electrolysis of Solutions of Metals."

Samuel S. Sadtler, Philadelphia, Pa.: "A Method of Electrolytic Production of Zinc from Its Ores."

Professor C. F. Burgess, University of Wisconsin, and Carl Hambuechen, Madison, Wis.: "The Electrolytic Rectifier."

Herman Schlundt, Ph. D., Madison, Wis.: "On the Relative Speed of the Ions in Solutions of Silver Nitrate in Pyridine and Aceto-Nitrile."

Carl Hering, Philadelphia, Pa.: "Fall of Potential in Electrolytes."

Chas. E. Acker, Niagara Falls, N. Y.: "Caustic Alkalies and Chlorine by the Dry Electrolytic Process."

Konrad Norden, Ph. D., New York city: "On a New Type of Electrolytic Meter."

Woolsey McA. Johnson, Hartford, Ct.: "The Reversible Copper Oxide Plate."

E. F. Roeber, Ph. D., Philadelphia, Pa.: "A Thermodynamical Note on the Theory of the Edison Battery."

Professor Jos. W. Richards, Ph. D., Lehigh University, Bethlehem, Pa.: "Electrolysis of an Aqueous Solution by Alternating Current."

Arvid Reuterdahl, Providence, R. I.: "The Atom of Electrochemistry."

An informal reception was held on Friday evening, April 4, at the Manufacturers' Club, and on Saturday afternoon a special train was taken to South Bethlehem, Pa., where the immense works of the Bethlehem Steel Company were visited, as were those of the Lehigh Zinc Works. The grounds and buildings of the Lehigh University were also inspected.

Among those present were the following:

C. J. Reed, Philadelphia, Pa.; Pedro G. Salom, Philadelphia, Pa.; Charles A. Doremus, New York city; W. D. Bancroft, Ithaca, N. Y.; Carl Hering, Philadelphia, Pa.; Samuel P. Sadtler, Philadelphia, Pa.; J. D. Darling, Philadelphia, Pa.; Wm. H. Wahl, Philadelphia, Pa.; E. F. Roeber, Philadelphia, Pa.; J. W. Richards, Bethlehem, Pa.; Woolsey McA. Johnson, Hartford, Ct.; W. D. Weaver, New York city; David H. Browne, Cleveland, Ohio; Arvid Reuterdahl, Providence, R. I.; Charles E. Lockwood, New York city; J. S. Granberg, New York city; Henry Howard, Boston, Mass.; N. S. Keith, New York city; Walter H. Hart, Philadelphia, Pa.; C. F. Burgess, Madison, Wis.; Chas. T. Child, New York city; C. W. Roepper, Philadelphia, Pa.; Alois von Isakovics, New York city; E. H. Mullin, New York city; C. M. Norman, Philadelphia, Pa.; Lawrence Addicks, Perth Amboy, N. J.; Hewey J. Skinner, Philadelphia, Pa.; Norman Dodge, Philadelphia, Pa.; J. C. Heckman, Buffalo, N. Y.; C. L. Collins, 2d, Niagara Falls, N. Y.; D. Foersterling, Perth Amboy, N. J.; Geo. Fred. Brindley, Niagara Falls, N. Y.; George M. Howard, Philadelphia, Pa.; E. F. Pegg, Philadelphia, Pa.; Hugh Rodman, Philadelphia, Pa.; Titus Ulke, Sault Ste. Marie, Ontario; Edward W. Smith, Philadelphia, Pa.; Chas. S. Doggett, Niagara Falls, N. Y.; Chas. E. Acker, Niagara Falls, N. Y.; Albert W. Smith, Cleveland, Ohio; Joseph W. Harris, Ashbourne, Pa.; Clinton Paul Townsend, Washington, D. C.; Herbert W. Dow, Midland, Mich.; Henry G. Morris, Philadelphia, Pa.; Adolph G. Rosengarten, Philadelphia, Pa.; Otto Luthy, Philadelphia, Pa.; Samuel S. Sadtler, Philadelphia, Pa.; Cecil P. Poole, New York city; Edward R. Taylor, Penn Yan, N. Y.; E. J. Hutchinson, Cincinnati, Ohio; E. W. Jackson, Philadelphia, Pa.; W. D. Harris, Philadelphia, Pa.; J. Frank McLaughlin, Philadelphia, Pa.; Geoffrey Charlton Adams, New York city; Wm. C. Banks, New York city; Frank M. Oliver, Philadelphia, Pa.; N. Monroe Hopkins, Washington, D. C.; Henry S. Carhart, Ann Arbor, Mich.; Frank D. Easterbrooks, Perth Amboy, N. J.; H. R. Carveth, Ithaca, N. Y.; Wm. A. Robbins, Philadelphia, Pa.; Jacob M. McConnell, Colwyn, Pa.; Marcus Ruthenburg, Philadelphia, Pa.; Thos. G. Hunter, Philadelphia, Pa.; W. J. Morrison, Jr., New York city; Samuel Reber, Washington, D. C.; M. G. Lloyd, Philadelphia, Pa.; Francis Forbes, New York city; Joseph C. Fraley, Philadelphia, Pa.; Edward A. Colby, Newark, N. J.; Edwin Morrison, Addingham, Pa.; Arthur H. Eyles, Addingham, Pa.; Frank M. Zeller, Philadelphia, Pa.; H. B. Coho, 149 Broadway, New York city; M. I. Wilbert, German Hospital, Philadelphia, Pa.; Henry S. Blackmore, Mount Vernon, N. Y.; B. M. Barr, Flatbush, L. I., N. Y.

The Interstate Telephone Convention.

Over Three Hundred Exchanges in the Central and Western States Represented at Chicago, and a Permanent Organization Formed.

Special Despatches to the ELECTRICAL REVIEW.

CHICAGO, April 9, 1902—The Interstate Telephone Association organized here to-day with a large attendance. About 300 independent telephone exchanges sent delegates from the states of Indiana, Illinois, Kentucky, Iowa, Wisconsin and Michigan. Among the manufacturing companies exhibiting telephone apparatus were the following: From Chicago—The Automatic Electric Company, Farr Telephone and Construction Supply Company, Keelyn Telephone Company, Globe Automatic Telephone Company, the Eureka Electric Company, Stromberg-Carlson Telephone Manufacturing Company, Western Telephone Construction Company, American Electric Telephone Company, Kellogg Switchboard and Supply Company, Electric Appliance Company, American Electric Fuse Company, Chicago Telephone Supply Company, Swedish-American Telephone Company, and Chicago Pay Station Company. From Cleveland—The North Electric Company, Williams-Abbott Telephone Company, Williams Electric Company, and American Toll Telephone Company. From Toledo—The W. G. Nagel Electric Company. From Boston—Holtzer-Cabot Company. From La Fayette, Ind.—The Sterling Electric Company. From Muncie, Ind.—The Warner Electric Company. From Trenton, N. J.—The John A. Roebling's Sons Company. From Pittsburgh—The Hipwell Electrical and Manufacturing Company. From Rochester, N. Y.—The Burglar and Fire Alarm Company.

Dr. I. A. Lumpkin, of Illinois, was elected president *pro tem,* and delivered an address in which he spoke of the advantages of such an association as a social acquaintance-making gathering, and urged that one of its principles should be the prevention of the formation of a second independent telephone exchange in one city. The object of the meeting, he stated, was to bring into closer alliance the telephone interests of the states represented and the formation of a plan whereby toll lines should be built from Chicago to and throughout the several states represented. Dr. Lumpkin stated that much of the work in connection with the association, owing to his ill health, had been done by his associates, Messrs. Nate, Dinsmore, McMeal and Burke, who had efficiently carried out the duties imposed at the preliminary meeting held January 7.

The association adjourned at 2.30 P. M., it being decided to elect permanent officers to-morrow, Thursday.

The balance of the afternoon was devoted to the inspection of the Chicago telephone factories, exhibits in the hotels and visits to other points of interest.

In the evening a banquet was given, lasting from 7.30 o'clock until midnight, at which much enthusiasm was displayed. The banquet was given with the compliments of the telephone manufacturers, and over 500 were present at the tables. Informal toasts were responded to by a dozen or more telephone men, and many absentees sent regrets by wire and letter. Mr. J. J. Nate presided at the banquet.

It is evident that the sense of the meeting, as gathered by your correspondent on the first day, is in favor of a strong permanent organization supplementing the work of the local state associations and of the National association, devoting especial attention to the field of operations of the central states. C. F.

CHICAGO, April 10—There was a large attendance at the Thursday sessions, both forenoon and afternoon. The following permanent officers were elected:

President, H. C. Rainey, Fairfield, Iowa.

Vice-president, Dr. I. A. Lumpkin, Mattoon, Ill.

Treasurer, J. A. Harper, Madison, Wis.

Secretary, E. C. Coleman, Louisville, Ky.

Papers were read by C. T. Bennett, of Waterloo, Iowa, and H. C. Rainey, of Fairfield, Iowa. Addresses were made by Richard Valentine, of Janesville, Wis.; L. A. Frazee, of Connersville, Ind.; E. R. Conklin, of Aurora, Ill. Considerable time was devoted to the election of officers and the discussion of general matters affecting the association.

Thursday evening a vaudeville entertainment was given in the Sherman House banquet hall, and attended and enjoyed by hundreds of the visitors. C. F.

CHICAGO, April 11—The proceedings on Friday were opened with an address by the newly elected president, Mr. H. C. Rainey. Other papers and addresses were read and delivered by W. H. Crumb, of Chicago; Jouett Shose, of Lexington, Ky.; Dr. H. S. Herr, of Ottumwa, Iowa; H. E. Ralston, of Marysville, Mo.; A. L. Hutchinson, of Weyauwega, Wis., and E. B. Fisher, Grand Rapids, Mich. The day's work concluded with reports of committees and general discussion.

The large attendance and the enthusiasm exhibited impressed all who were present with the great importance of the telephone industry along independent lines. C. F.

Telephone Securities.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In the ELECTRICAL REVIEW of April 5, Mr. Guy M. Walker presents an interesting portrayal of the difficulties encountered in satisfying "the extraordinary demand for telephone service" that merits careful reading, even though one may not agree with all of Mr. Walker's conclusions.

Mr. Walker believes that independent telephone companies are "fortunate in having delayed their period of activity until the time when telephone development has reached a high state of perfection," yet he cites one plant which "has been made the 'trial horse' for the whole independent system. It has been the plant on which nearly all experiments with new schemes and new apparatus have been made, experiments which have been costly to the company, but the benefit of which the other independent companies have reaped." Yet, notwithstanding these costly experiments, "the result of the company's operation is that the active productive use of one-half of its plant is actually paying its operating expenses, maintenance, fixed charges and a surplus of $35,000 a year on a total investment twice that which is active and producing."

Mr. Walker also believes that the real weakness of telephone securities lies in the uncertainty of the total investment necessary to build any given plant.

In so far as large investors are concerned the "real weakness of telephone securities" lies in the fact that properly prepared financial statements do not usually accompany applications for the placing of telephone securities. Hence,

Mr. Walker can be of inestimable benefit to the independent fraternity by showing that the facts that must be brought out are as follows:

Outstanding stock, total.
  Outstanding stock per station.
  Outstanding bonds, total.
  Outstanding bonds per station.
  Gross income, total.
  Gross income per station.
Disbursements distributed per station.
  Operating expense.
  Maintenance expense.
  General expense.
  Taxes.
Net income, total.
Net income per station.
Appropriations distributed per station.
  Interest on bonds per cent.
  Sinking fund for bonds per cent.
  Depreciation per cent.
Surplus, total.
  Surplus per station.
  Telephone stations.

Mr. Walker makes so good a showing for his second company that he can well afford to give the readers of the ELECTRICAL REVIEW a more detailed presentation as outlined above, to the end that they may use the data so generously given to aid in floating their own securities.

The proper amount to be charged for depreciation is often a problematical one. But in the same issue of the ELECTRICAL REVIEW an eminent electrical engineer says that "the depreciation factor on the plant should not be taken too low, as there are so many unforeseen incidents, such as blizzards, menacing pole lines, new inventions making switchboards obsolete, etc., that may deplete the treasury in a short time. The allowance for depreciation should not be below ten per cent on the switchboard; fifteen per cent on open wire pole lines; four per cent on conduits; twelve per cent on cables."

Mr. Walker concludes that the results accomplished by independent telephone companies "would warrant one in saying that to the investor who desires to buy a single bond or a dozen bonds that his security is good and his returns sure, but to original investors, who project the plants and make the first investment of capital, the business is undoubtedly fraught with dangers, and the safest sphere of operation, and the one from which the best and safest returns are secured is in the smaller or medium-sized cities of the country."

Now the question arises: Is it the size of the city or the size of the rates that makes safe "the sphere of operation?" Our opponents find the richest returns in the larger cities and charge "what the traffic will bear." Why should the Independent copy after the Bell in construction, operation and maintenance, but go only a third of the way in the matter of rates? The low rate was a serious error, due entirely to inexperience in the first place, and its continuance is not and never has been demanded by the more intelligent users of telephone service who have an appreciative understanding of the great risks that independent telephone men have taken in the effort to introduce an era of low telephone rates. Sooner or later every company will learn that to continue to furnish service at too low a rate is to completely undermine the integrity of its investment, to deprive its subscribers of improvements that a higher rate would justify, and to slowly but surely pave the way for the seceding of the subscribers to the enemy by reason of inability to give first-class and up-to-date service.

FRED DELAND.

Pittsburgh, April 5.

The Electric Light Convention.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

Advices from various sources lead us to believe that our coming convention, to be held at Cincinnati, May 20-22, will be more largely attended than any ever held by this association. Not only has there been a great increase in our actual membership, but more non-members are inquiring about the meeting than ever before, many of them expressing an intention to join the association at that time. Our programme will include fewer technical papers than usual, but fifteen or twenty topics of practical interest to central station managers have been selected, and competent men asked to prepare discussions upon them. These discussions will be printed before the meeting, and brought up there for further consideration by all the members. A few of them are as follows: Rates; hot water and steam heating; free lamp renewals; loose-leaf ledgers; uniform accounting; three-phase *vs.* two-phase for city distribution; improvements desired in meters; caring for consumers' complaints. Other topics will be announced as soon as arrangements are perfected for their discussion. This method of making up our programme is sure to render the meeting most attractive and instructive, and will result, we are convinced, in practical benefit to all our members.

The meetings will be held in the Grand Hotel, the headquarters of the convention.

The Central Passenger Association has granted a rate of a fare and a third from all points in this territory to Cincinnati and return, and the other associations will undoubtedly grant the same rate, due notice of which will be given.

GEORGE F. PORTER, Secretary.

New York, April 10.

General Electric Stock Dividend.

It is believed that a stock dividend will be paid to the shareholders of the General Electric Company amounting to 66 2-3 per cent of their present holdings. This will be made possible when the stockholders approve at the meeting to be held at Schenectady on May 5 the recommendation of the directors that the company's stock be increased by $19,757,000 or to $45,000,000. The stock dividend will reimburse the stockholders for the stock that they gave up when, on August 17, 1898, the company's common stock was reduced from $32,161,000 to $18,276,000. A dividend of 66 2-3 per cent on the last-stated amount would call for $13,885,000. It would restore what was given up.

There has been an increase in the common stock to $24,784,600 to retire $5,298,000 debenture bonds and the $2,551,200 preferred stock of the company, all of which except a nominal amount has been called in. A dividend of 66 2-3 per cent on $24,784,600 common stock will call for $16,523,066.

The General Electric Company paid in dividends last year 9 per cent on its common stock, but the net earnings are said to have amounted to more than 32 per cent.

On the New York Stock Exchange on Wednesday of this week the price of General Electric stock touched 334 a share—a new high record—closing at 329.

Westinghouse Electric and Manufacturing Company common advanced to 230½ and closed at 226 on the same day. The preferred reached 234.

The following despatch from Pittsburgh, dated April 9, appeared in the New York *Sun:*

W. D. Uptegraff, Mr. Westinghouse's confidential man, was told to-night of the rumor in New York that the control of the Westinghouse Electric was passing from Mr. Westinghouse to the Morgans or the General Electric Company.

"There is nothing in it," said Mr. Uptegraff. "The control of Westinghouse Electric lies absolutely with Mr. Westinghouse, and it can not be taken away from him by any manipulation of the stock market."

"Might Mr. Westinghouse be disposing of his own accord of his controlling interest?" Mr. Uptegraff was asked.

"No. He holds the control and will continue to hold it."

"To what do you ascribe the rise in the stock?"

"To manipulation of the stock market," replied Mr. Uptegraff. "And we have nothing to do with the manipulation."

Electrical Patents

A new alternating-current motor has been devised by Benjamin G. Lamme, of Pittsburgh, Pa., and the Westinghouse Electric Manufacturing Company has taken out a patent thereon. The accompanying illustration shows the motor when designed for use in operating a fan, and a diagrammatic view is also presented of the circuits. The primary member 2 of the motor 1 has a cylindrical core 3, preferably laminated, as is usual in motors of this general character, and provided with a plurality of sets of slots cut in the inner cylindrical face of the core. As shown, there are four sets of these slots, but any other even number of sets desired may be provided. Each of the sets comprises two outside slots 4 and two inside slots 5, the sides of which are parallel to each other and to a radial plane, so that the coils 6 and 7 may be machine-wound and of the proper form and dimensions to be readily slipped into place in the slots and around the enclosed teeth or polar projections formed by such slots. While these coils will ordinarily be oblong in form, their arrangement may be generally described as concentric, and the number of slots and coils belonging to each set may be greater than what is shown, or a single pair of slots and a single coil in lieu of the two pairs of slots and two coils may be employed. The arrangement shown was adopted because it permits the use of a relatively long winding without making the slots of great width. The coils of each set are connected in series so that they constitute, in effect, a single coil, and may therefore be so designated, so far as the electric and magnetic conditions are concerned. The sets of slots and coils are so disposed as to provide intervening spaces 8 of considerable width, the inner faces of which lie in the same circle as the inner ends of the teeth or polar projections formed by the slots. It has been found desirable to employ in connection with the main propelling coils closed secondary coils axially displaced with reference to the main coils in order that a sufficient displacement or distortion of the magnetic field may be obtained for starting purposes. Such starting coils are indicated at 9 in the drawings. The secondary member 10 of the motor may be of the well-known squirrel-cage type, as indicated, and its shaft 11 may have mounted upon it the fan-blades 12, as indicated, or a suitable pulley in case it is desired to utilize the motor for other purposes than for revolving fan-blades. The frame or stand 13, on which the parts already described are mounted, is provided at its base with stationary contact terminals 14, 15, 16

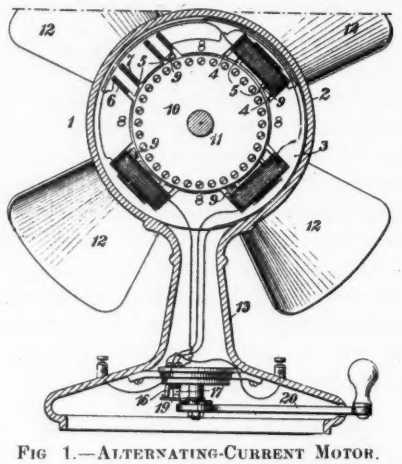


FIG 1.—ALTERNATING-CURRENT MOTOR.

and 17, to which are connected leads from the propelling coils 6 and 7 and with which engage contact members 18 and 19 operated by suitable switch-arm 20. In describing the operation it will be assumed that the coils of each set are so connected as to constitute, in effect, a single coil, and for convenience of description the several combination coils are designated as *a*, *b*, *c* and *d*. It will be seen that with the controlling switch in the position indicated in Fig. 2 the circuit will be from the supplying conductor

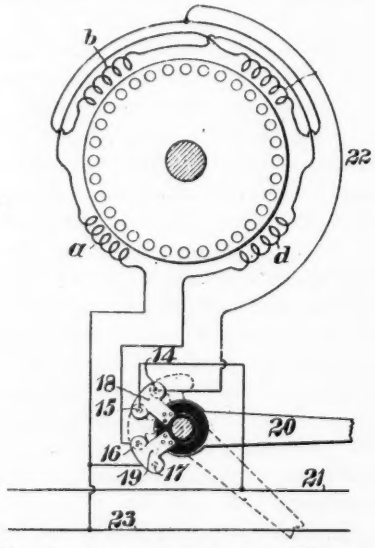


FIG. 2.—ALTERNATING-CURRENT MOTOR.

21 through terminal 15, and contact 18, terminal 14, conductor 22, and coils *c* and *a* in series to supply conductor 23 and from conductor 22 through coils *b* and *d*, terminal piece 16, contact member 19, and terminal 17 to supply conductor 23. With this arrangement of coils and circuits the coils are so energized as to produce poles of opposite sign that alternate with each other, as is usual in electric motors. This arrangement will afford the maximum motor speed. If now the switch-arm 20 be moved to the broken line opposite, the coils *a*, *b*, *c* and *d* will be connected in series, and the connection will be such that the magnetic poles produced thereby, which correspond in position to the coils, will all be of the same sign, the poles produced by coils *a* and *c* being unchanged and those produced by the coils *b* and *d* being reversed from what they were with the switch in the position already described. With the arrangement of coils indicated it follows that consequent poles will be produced in the intervening spaces 8, which will be of the same sign, but of the opposite sign to the poles corresponding in position to the coils. We shall thus have eight poles which alternate with each other in sign, and consequently the speed of the motor will be reduced substantially one-half.

Discharge Potential of Hydrogen.

The difference between the discharge potential of hydrogen at a platinum and at a mercury cathode at — 85 degrees is nearly the same as the difference at 18 degrees. From this Messrs. A. Coehn and E. Neumann have concluded that since in one case the mercury is solid and in the other case it is liquid, the discharge potential of hydrogen at metal cathodes is dependent, not on accidental properties of the metals, such as the form and nature of the surface, but on the chemical individuality of the metal.

In a recent research by Mr. Rudolf von Hasslinger into the potential differences in vapors and in some solid electrolytes the potential differences assumed by metals when placed in a Bunsen burner into which solutions of various salts are sprayed have been measured. The basic as well as the acid constituent of the salts influences the potential differences, the greater part of which, however, seems to be due to the latter. It was observed that in the vapor of certain salts iron and nickel assume a positive potential toward platinum, while in fused lithium chloride iron is negative toward platinum. The difference of potential varies with the temperature, the maximum value being reached at about 800 degrees, and upon further raising them the electro-motive force decreases, and the lithium chloride vapors pass through zero to the change of sign. This same phenomenon takes place with the solid electrolytes, calcium and magnesium oxides.

Important Transformer Decision.

An important decision has recently been rendered by Mr. Justice Lacombe, in the United States Circuit Court of Appeals for the Second Circuit, in the case of the Westinghouse Electric and Manufacturing Company *versus* the Saranac Lake Electric Light Company. Suit was originally brought by the Westinghouse company upon the transformer patents of Rankin Kennedy and William Stanley. The Circuit Court in which the case was tried held the Kennedy patent to be void and the first and third claims of the Stanley patent to be valid and infringed by the defendant. Upon cross-appeals the case was taken to the Circuit Court of Appeals, which has rendered its decision in the following highly interesting opinion of Mr. Justice Lacombe:

The Kennedy patent is for an improvement in the method of distributing and regulating alternating electric currents by secondary generators. The patentee arranged secondary generators (transformers) in multiple; they had theretofore been arranged in series. When so arranged they became self-regulating as to primary current and power; in other words, each transformer would take its proper share of current, varying according to the number of lights burning on it, so that the lights on one transformer were independent of the lights on another transformer. In the more technical language of the claim, the system

consists in producing in two or more derived circuits constituting the primaries of two or more secondary generators a counter electro-motive force which, when any secondary is open, is practically equal to the applied electro-motive force in its primary and in controlling said electro-motive force by the current flowing in the corresponding secondary when the secondary is closed, in such manner that the current in the primary shall vary with and be approximately inversely proportional to the resistance in the secondary.

The judge who heard the cause at circuit held, among other things, that certain acts and omissions of Kennedy taken together worked an abandonment and dedication of his alleged invention to the public. We fully concur in his discussion of this branch of the case, which will be found in his opinion, and deem it unnecessary to add anything further, affirming so much of the decree as disposes of the Kennedy patent upon such opinion.

The patent to Stanley deals with the same branch of the electric art and is an improvement on Kennedy's. After Kennedy had arranged his transformers in multiple, the lights on one transformer were independent of those on another, but nevertheless the candle-power on any given transformer changed as the number of lamps lighted on that transformer varied. When more lamps were turned on, the candle-power of all went down, and when lamps were turned off, the candle-power of those remaining increased. Stanley's improvement was directed toward overcoming this defect.

The specification says:

The factors of the operation of my system of distribution are employment of an alternating-current generator supplying currents of approximately constant potential, main lines extending throughout the system of distribution, converters or transformers connected thereto, and translating devices located in the secondary circuits of the transformers, by the employment of which a sympathetic relation exists between the different operations of the system to the end of maintaining a simple and accurate self-regulation, so that the absorption of energy by the generator is proportional to the energy usefully consumed. The current developed by the dynamo D may be of as high potential as desired. . . . These converters may be of any construction; but are preferably constructed to have the greatest magnetic conductivity in their magnetic circuits.

There are certain principles of construction which must be adhered to in the proportioning of the parts of the converter in order to secure the desired results and which I will now state. It is necessary in the first place that the conductivity for magnetic force of the magnetic circuit of the converter shall be of so great value that when subject to all degrees of magnetization accruing from the various amounts of energy transformed its conductivity for magnetic force would be approximately the same. This point of construction is important for two reasons: First, the greatest economy of conversion is obtained when the rise and fall of magnetism in the core is proportional as nearly as possible to the rise and fall of the current in the primary coil, and this condition is attainable only by keeping the core far below the saturation-point; and, second, the same condition secures the largest possible counter electro-motive force in the primary coils of the converters. This is indispensable for regulation, as hereinafter set forth. It is impossible to state the exact relation between the weight of the core and the strength of the current. I have found the minimum amount of iron necessary to produce satisfactory results to be one pound of iron for every twenty-five watts, which amount is equivalent to two pounds of iron per lamp with the lamps heretofore generally used by me. . . .

In the construction of the coils P and S, the following principles are to be observed: The first thing to be determined is the length of the primary wire. This should be of such length that reacting self-inductively upon its own magnetic circuit the average counter-potential so produced approximately equals the potential applied to the primary circuits. When so constructed, an ammeter will practically show no current when the secondary circuit is open. To obtain these results in practice I use the following methods: I first choose the percentage of efficiency to be obtained. Then having selected a type of magnetic circuit affording as great magnetic conductivity as possible I apply such a length of primary conductor that acting self-inductively upon its core the difference of the counter-potential and applied potential multiplied by the current in the converter shall equal the predetermined loss of energy inevitable in conversion and vary the length of primary wire until the desired results are attained. It is obvious that the coefficients of induction in the dynamo and armature and converter may be made equal by energizing each circuit with the same induction.

In the carrying out of my invention it is possible to use the same coefficients of induction in the armature and the dynamo as are present in the primary circuit of the converter; but this equality is not necessary. Having by these means determined the length of the primary coils, the secondary is adapted to it in such a manner as to secure the desired potential according to the well-known laws effecting the operation of induction coils. I have usually related the potential of the secondary to the primary in the ratio of twenty to one. The size of the wire in the primary and secondary coils is in inverse proportion to their electro-motive forces.

The claims involved are:

1. In a system of electrical distribution, and in combination, an alternating-current dynamo and converters electrically connected with the main-line conductors in multiple arc and organized to transform the current in the main conductors into currents of less potential and greater quantity in the secondaries, each converter made with a primary coil containing such length of wire exposed to magneto-electric induction that when operated by the dynamo with which it is to be used with its secondary circuit open the electrical pressure and counter-pressure in its primary circuit shall be equal with incandescent lamps or other translating devices in the secondary circuits, substantially as and for the purposes set forth.

3. In a system of electrical distribution, and in combination, an alternating-current dynamo and converters organized to transform the current generated by the dynamo into currents of less potential and greater quantity at or near the points of consumption electrically connected with the main-line conductors in multiple arc and having their primary circuits constantly closed, each converter adapted to the dynamo operating the system by making its primary coil of such length that when supplied with its full proportionate share of the entire normal electro-motive force of the machine, its secondary circuit being open, the electrical pressure and counter-pressure in its primary circuits shall be approximately equal with translating devices in the secondary circuits of the converters to be cut out of the circuit when not in use without the introduction of any resistance in the place of them, substantially as and for the purposes set forth.

As stated before, after the Kennedy improvement, a difficulty still existed in that the candle-power went up or down as lamps on any particular transformer were turned on or off. Stanley suggested that the difficulty was due to an improper length of wire on the primary, and among much else he states precisely, specifically and exactly what that length should be. The amount of wire for a given character of current supply can not be stated in feet and inches, because it is, to some extent, dependent upon other things, such as the quality of iron employed in the core, the quality of copper used in the coils, the shape of the transformer and the way the coils are applied. The Stanley patent, recognizing these variable elements, gives a rule applicable to all conditions. It says you may determine the proper length of the primary coil by connecting the transformer in circuit with the dynamo with which it is to be used, and then winding on wire until the loss indicated by the formula C^2R, with the secondary circuit open, equals a certain loss of energy.

The field of invention lies in that obscure and difficult art which is so hard to be understood by those who have not constant practical experience with its phenomena, its laws and its nomenclature, and deals with a branch of that art which is still evidently in dispute between those who have carefully studied it. It is fortunate, therefore, that we find the concession in defendant's brief that the rule above set forth for determining just what shall be the length of primary coil is not

found in any prior patents or publications, for, with this concession, it is easy to determine from the record that there is no anticipation shown. It is contended, however, by the defendant that this so-called Stanley rule is no part of the invention claimed; that there is nothing in the claims requiring the rule to be considered as a part of the invention thereby covered; that it is merely in the nature of a recommendation, the patentee saying:

In practice I use the following method,

being the so-called rule. The first claim (and in that respect the third claim uses similar language) prescribes for the primary coil

such length of wire exposed to magneto-electric induction that when operated by the dynamo with which it is to be used

under certain conditions, certain results will follow. Concededly the man skilled in the art would not have found in that art anything which would have told him precisely what that length of wire should be. The claim does not give any formula for determining what it should be, and if the specification were equally silent, there might be some question as to whether Stanley had really contributed anything of importance to the art; certainly it would yet remain for others to inform the art just how to find out a length which would operate as indicated in the claim. But when the patentee in his claim enumerates as one element of his combination a wire of a length which will accomplish the result sought to be achieved, and his patent discloses a method for determining that length with mathematical exactness, his claim may fairly be sustained for the length thus shown, although it might be that some other length covered by the language of the claim but not of the rule, would fall outside the claim. The

length of wire exposed, etc., operated by etc. . . . substantially as set forth,

is the length of wire that the specification shows as the result of a given formula. The so-called Stanley rule is, therefore, a part of the invention disclosed and claimed in the patent—indeed, it would seem to be the main part of that invention—and with the patent thus constructed the citations from the prior art show neither anticipation nor lack of invention. The whole argument of defendants on that branch of the case is so interwoven with the postulate that the Stanley rule is to be eliminated from the patent that when the postulate is not granted the argument becomes wholly unpersuasive.

The application for the Stanley patent was filed August 15, 1888, and defendant contends that prior to August 15, 1886, there was a public use by Stanley, at Great Barrington, Mass., of which town he was a resident, of a system of electrical distribution embodying the combination of apparatus described and claimed in his patent. The testimony touching this alleged public use more than two years prior to application is voluminous and the judge who heard the cause at circuit has reviewed it at length. The combination of apparatus was set up there, wires were strung, lights were lit in the premises of users in the town, and the plant run, with some intermissions, from March 16 to June 16, when the dynamo broke down and it was never operated again. A charge was made for lights, an extremely small one, insufficient to pay expenses, and intended really as a convenient way by which Stanley might avoid embroiling himself with his neighbors, as he probably would do if he gave free light to some and not to all; the plant was not large enough to furnish all the lights the town could use. The invention was of a character which required testing under conditions which could be found only when the test was made in public and continued for a reasonable length of time, and under the authorities the charging of an unremunerative price for the product of the combination is not absolutely controlling, though it raises a presumption against experimental use, which can be overcome only by clear and convincing evidence. We concur with the judge at circuit in the conclusion that the use was experimental and in the argument by which he reached that conclusion, except that we are inclined to attach little, if any, weight to the fact that the engine and generator were out of public view in an old mill and the converters locked up; such protection against the elements and against tampering with important and dangerous parts of the apparatus would be expected in purely commercial public use. The most persuasive evidence, in our opinion, is found in the circumstance that when the Great Barrington plant broke down after its brief experience, the persons in control of the Westinghouse company, for whose benefit (as assignee of the future patent) the combination of apparatus was kept at work, were still so unconvinced that the practical success of the system had been demonstrated that they expended thousands of dollars more in erecting another plant for a further use of the combination of apparatus at Lawrenceville—a use that concededly was wholly experimental.

Infringement of the first and third claims is not substantially disputed except upon the theory that the amount of iron contained in the cores of defendant's transformers is such as to take them out of the claims of the patent. The claims do not specify any particular amount of iron, but defendant contends that a statement in the specification (quoted above) to the effect that the minimum amount of iron should be

one pound of iron for every twenty-five watts

must be read into the claims. A careful perusal of the text of the specification shows this contention to be unsound. The patentee states that there are certain

principles of construction which *must be adhered to*

in proportioning the parts of the converter in order to secure the desired results; that "it is necessary" that the conductivity for magnetic force of the magnetic current of the converter shall be of so great value that when subject to all degrees of magnetization accruing from the various amounts of energy transformed its conductivity for magnetic force would be approximately the same; that

this point of construction is important for two reasons: *first*, the greatest economy of conversion is obtained where the rise and fall of magnetism in the core is proportional as nearly as possible to the rise and fall of the current in the primary coil, and this condition is attainable only by keeping the core far below the saturation-point; and, *second*, the same condition secures the largest possible counter electro-motive force in the primary coils of the converters.

"This," says the patentee in his specification, "is indispensable for regulation." Having thus set forth an "indispensable principle of construction," which may fairly be read into the claim, the patentee, in quite different language, states the precise proportion of iron to current which he has used successfully.

"*It is impossible*," he says, "to state the exact relation between the weight of the core and the strength of the current. I have found the minimum amount of iron necessary to *produce satisfactory* results to be one pound of iron for every twenty-five watts, which amount is equivalent to two pounds of iron per lamp *with the lamps heretofore generally used by me*. Thus in constructing a converter designed to supply twenty incandescent lamps I use a core weighing about forty pounds."

We are clearly of the opinion that defendants do not escape infringement of the first and third claims because by reason of their using one pound of iron instead of two for a fifty-watt lamp, so long as they adhere to the "indispensable principle" of construction set forth in the specification. Inasmuch as the proof shows that their construction does so adhere their device infringes.

The decree of the Circuit Court is affirmed with costs.

Book Reviews.

"The Copper Handbook." Horace J. Stevens, Houghton, Mich. 1902 edition. 416 pages. Octavo, with advertising section of 80 pages. In buckram binding, $2.00. In full morocco, $3.00.

This book is contained in ten chapters, on the history, chemistry, mineralogy and metallurgy of copper; a glossary of mining terms in common use; copper deposits of the United States; copper deposits of the world; leading foreign mines; Lake Superior mines and statistics of the copper industry of the world. This appears to be a very valuable publication and seems to embrace everything of importance connected with the copper industry throughout the world.

"The Rœntgen Rays in Medicine and Surgery." Francis H. Williams, M. D., New York. The Macmillan Company. Cloth. 658 pages. 5¾ by 8½ inches. 390 illustrations. Supplied by the ELECTRICAL REVIEW at $6.00 net.

Dr. Williams states in the preface of his work that the book is intended rather to be a report of progress than a final presentation of the subject. Perhaps on this account the omission of any reference to a good deal that has been done may be forgiven. The work, while not exhaustive, is one of considerable value, particularly to physicians or surgeons interested in actually applying X-rays in the diagnosis of patients. The work is beautifully illustrated and contains much information of importance to the medical profession.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Electric Controlling Apparatus.

That no one design of controller is best adapted for all varieties of service is well known, and great efforts have been made by manufacturers to perfect special

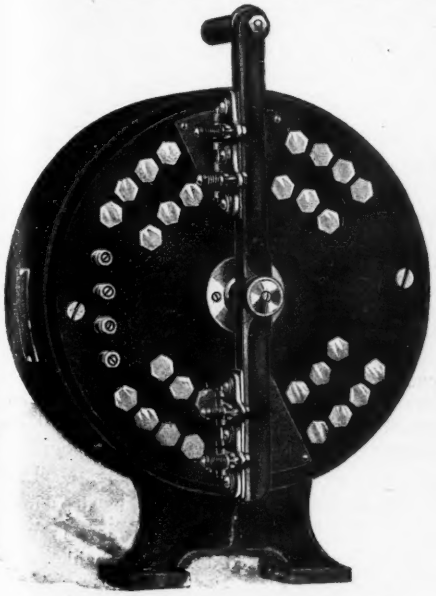


FIG. 1.—FRONT VIEW OF TYPE "U" CONTROLLER.

forms of control for certain types of apparatus. The Electric Controller and Supply Company, of Cleveland, Ohio, has added to its line of manufactures a new

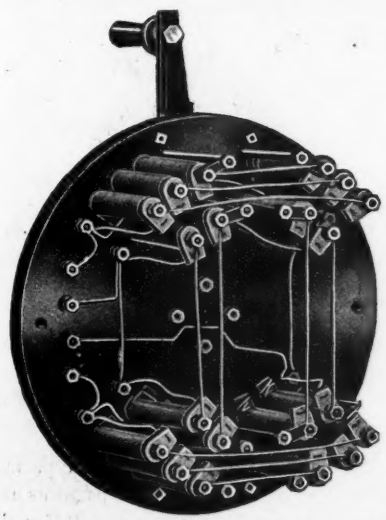


FIG. 2.—SHOWING REAR VIEW OF SLATE FACE AND CONNECTIONS.

design of controller known as the type "U," which is particularly adapted for the control of standards, cranes and other electrically driven machinery which is not subjected to excessive overloads. Referring to the illustrations, a front view of the type "U" controller is shown in Fig. 1, Fig. 2 being a rear view of the slate faces showing the resistance units and connections. All of the working parts of the controller are carried by the slate face, the frame, which consists of a single casting, serving simply as a protection and a support for the working parts. A ready inspection of all the controller connections is secured by the removal of two screws, freeing the face from the frame. The detail of construction of one of the resistance units is shown in Fig. 3. The core of the unit is a rod of soft iron, over which is placed a heavy tube of asbestos, caps being provided at either end of the tube for receiving the ends of the resistance winding, the cap at the rear end of the tube being of insulating metal and that at the forward end of copper, threaded on the iron core. The core is extended beyond the copper cap and passes through the slate face, where it is locked in position by a lock nut working in a counter-bored recess. The contact button is drop-forged from pure lake copper, and is grasped with a wrench and screwed in place on the end of the core. By this construction, the contact button may be removed and replaced without in any way disturbing the resistance unit or its connections.

FIG. 3.—DETAIL OF CONSTRUCTION OF RESISTANCE UNIT.

In operation the iron core of the unit performs three functions — carrying the forward end of the resistance winding, the rear end of the unit thus bringing all connections to the various units into one plane, connecting the resistance winding to the contact bottom, and forming the core of a powerful electromagnet of which the turns of resistance material form the

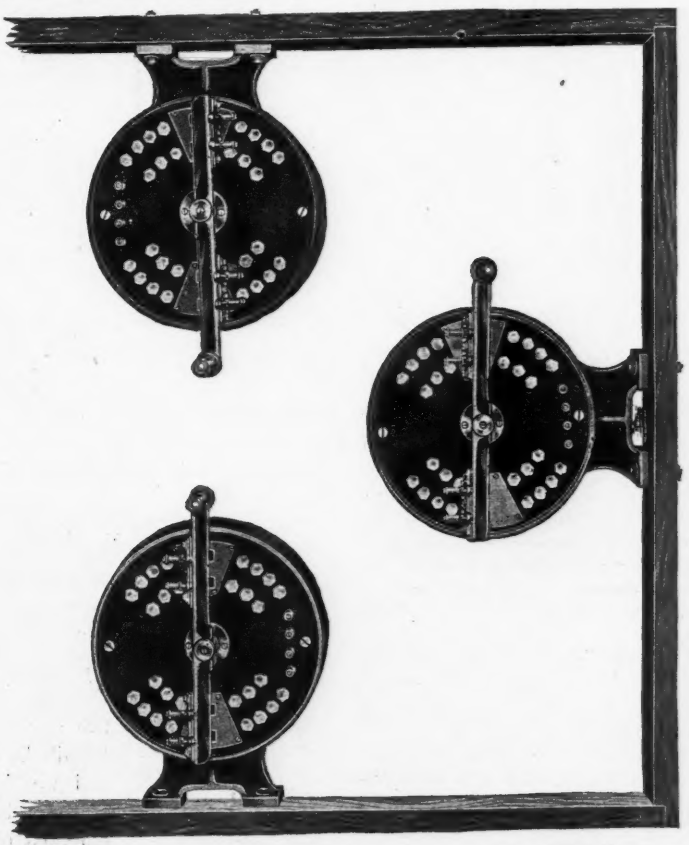


FIG. 4.—SHOWING A VARIETY OF METHODS OF SUPPORT, THE LEVER BEING KEPT IN A VERTICAL POSITION.

exciting winding. This construction places each contact in a powerful magnetic field of its own and provides an efficient blow-out.

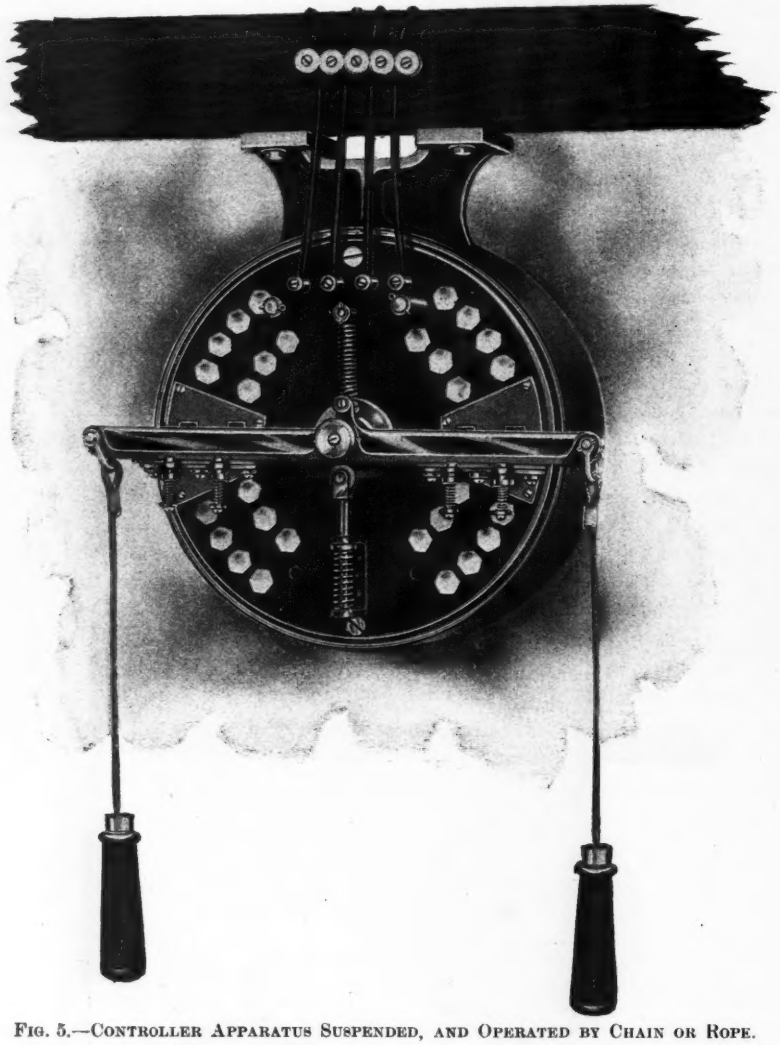


FIG. 5.—CONTROLLER APPARATUS SUSPENDED, AND OPERATED BY CHAIN OR ROPE.

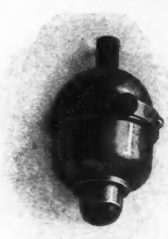
In Fig. 4 is illustrated a further feature of this type of controller. The frame is finished with four bosses set at ninety degrees apart. By altering the position of the two screws which hold the face in the frame, the controller may be adapted to a variety of methods of support, maintaining the operating lever in a vertical position, further flexibility being given to the handle by it being adaptable to attachment with the operating lever in three positions.

Fig. 5 shows this type of controller adapted to overhead support and operated from the floor by means of a chain or rope. The arm is returned to the off position by a powerful spring when the ropes are released. This type of controller has been the subject of much favorable comment.

Improved Pendent Push-Button Switches.

The many uses to which pendent push-button switches are adapted for either temporary or permanent installations of incandescent lamps, multiple arc lamps or electric fans have placed them among the list of necessary electrical supplies. Their small size and convenience of operation recommend them particularly for use in residences. They are quite generally used in connection with fan motors, which in such cases may be placed in the most advantageous points regardless of accessibility.

The General Electric Company's pendent push-button switches are made for 125-volt circuits of five and ten amperes and 250-volt circuits of five amperes. The terminals, contacts and working parts of the switches are mounted on a substantial porcelain base.



PENDENT PUSH-BUTTON SWITCH.

The contacts for the switches are all of ample size for carrying the current required and so constructed as to withstand severe service.

The 250-volt switch is designed with two breaks in series and has knife-blade contacts. The contact surfaces are amply proportioned and the entire mechanism is substantial and thoroughly reliable. The switch is entirely enclosed by a polished brass casing which is fibre-lined and fitted with an insulating bushing at the opening for the lamp cord.

The circuit is closed by pushing the rubber button which is attached to a metallic plunger inside the switch, and is snapped open by pressing the release button on the side of the switch.

These buttons are threaded and screw into their respective positions.

The five-ampere, 125-volt switch is one and five-eighths inches in diameter, the other two switches measuring one and seven-eighths inches in diameter.

The Vought-Berger Company.

At a recent meeting of the directors of the Vought-Berger Company, La Crosse, Wis., C. A. Sterling was elected president, C. W. Thompson, vice-president, and M. I. Berger, secretary and treasurer. Mr. Berger will also assume the duties of general manager. On March 1 Mr. G. L. Saunders joined the company's corps of telephone engineers. Mr. Saunders is an engineer of remarked ability and wide experience both in telephone manufacturing and construction work.

In order to supply the growing demand for its pendent telephone the company has been compelled to move into larger quarters, where, with improved equipment and increased capacity, it will be in a position to give its many patrons better service than ever before. In the machine

M. I. BERGER.

shop, well fitted with the latest type machines and labor-saving tools, patterns and dies are being rapidly turned out for the new V-B switchboard, which appeared on the market April 1.

The company with strong financial backing, controlling valuable patents, is becoming an important factor in the Independent telephone field.

Protective Devices.

The Stanley Electric Manufacturing Company's type "H" or "Ball" fuse which is illustrated in the accompanying engravings, has been in service for a number of years and well maintains its position as a high-grade piece of apparatus for general service with voltages up to 30,000. The appearance on the board of this type of fuse is shown in Fig. 1, while the interior is well shown in Figs. 2 and 3. This fuse has been subjected to most severe tests, 30,000 volts at fifty amperes having been applied directly to the combination with no failure to operate satisfactorily. All the live parts of the apparatus are so insulated as to afford thorough protection for the switchboard attendant. For voltages over 10,000 the fuse is mounted as shown, but for lower voltages no porcelain insulators are used in mounting.

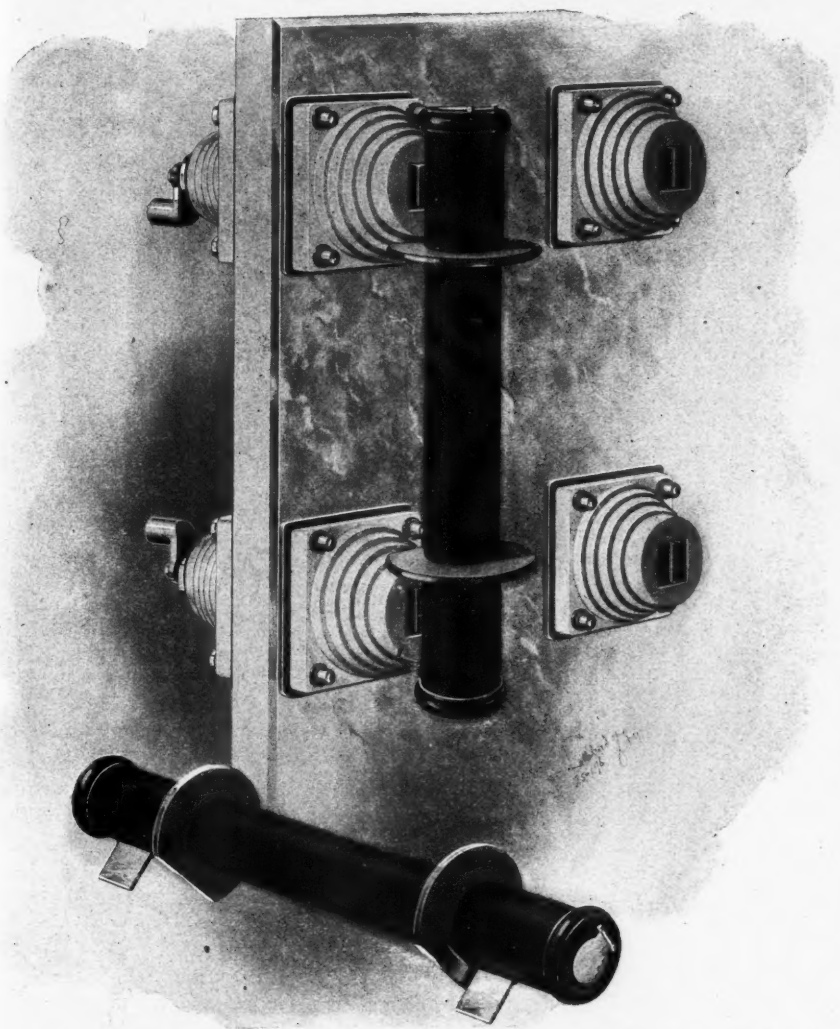


FIG. 1.—APPEARANCE OF "BALL" FUSE PROTECTIVE DEVICE MOUNTED ON BOARD.

At each end of the tube which encloses the fuse proper (see Fig. 2) is a chamber which contains a small carbon ball. These chambers are large enough to contain the ball without interfering with the proper passage of the fuse wire. When fusing takes place the vapors resulting from the combustion of the metal blow the carbon balls into the cavities (A), effectively cutting off the arc. At the top of the tube and hinged on its upper cap is a small aluminum tell-tale (V), which covers a circle of perforations. The outrush of gases incident to fusing throws this little vane over and into view of the attendant, indicating that the fuse has gone. The cap, including the contact jaw, makes a snug fit over the fuse terminal (D). The latter carries the machine screw holding the eccentric washer (E). Around the screw and under the washer is clamped the fuse wire. The cap carrying the jaws is released by a slight twist, slips off the barrel and exposes the washer and screw. Here fusing is the work of a very short time and ordinary fuse wire is used.

Fig. 3 shows exactly what happens at the instant the ball fuse operates. Perforations are provided at both ends of the barrel for the exit of combustion vapors, but the path is a devious one, and by the time the vapors reach the atmosphere they are harmless. An extra barrel kept on hand and fused makes feasible the reestablishing of a circuit almost immediately.

In Figs. 4, 5 and 6 is illustrated model No. 3 of the S. K. C., type "F" high-capacity fuse. The fuse proper is of aluminum and is mounted in a lignum vitæ case. Extensive experimenting with large currents at high voltages has demonstrated that this wood gives the best service of any material available for carrying such fuses.

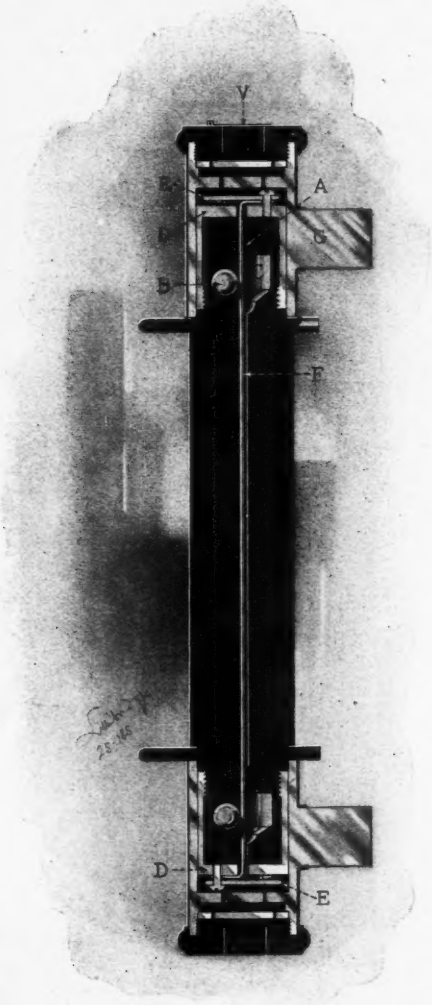


FIG. 2.—INTERIOR OF "BALL" FUSE PROTECTIVE APPARATUS.

The construction of the type "F" fuse is such that when the combination is assembled, that portion of the aluminum pieces of smallest cross-section is virtually enclosed in a blowing chamber, as is shown in Fig. 4. The cap is secured by thumb-nuts (see Fig. 5) and when in

place the tongue fits snugly into the groove bounding the discharge chamber effectively confining the exit of molten

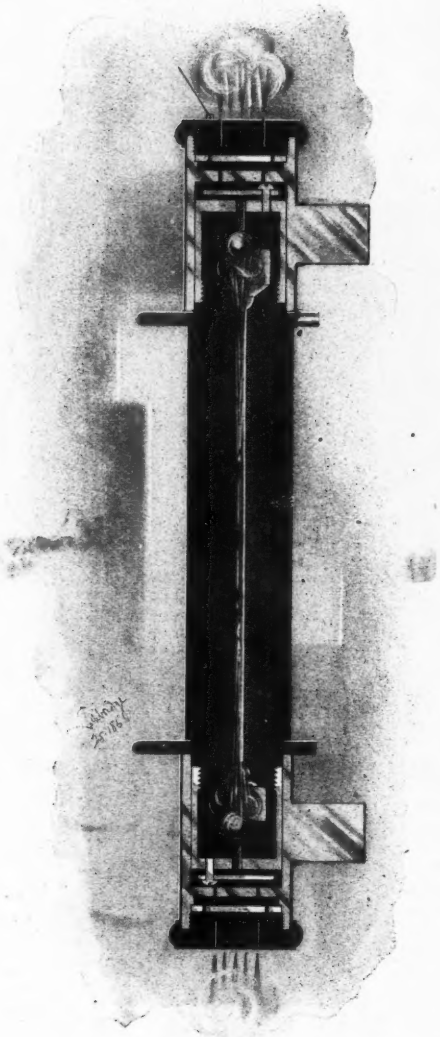


FIG. 3.—AT MOMENT OF FUSING.

fuse to the rear, as is shown in Fig. 6. The opening is covered with a piece of mica and provides means for observing

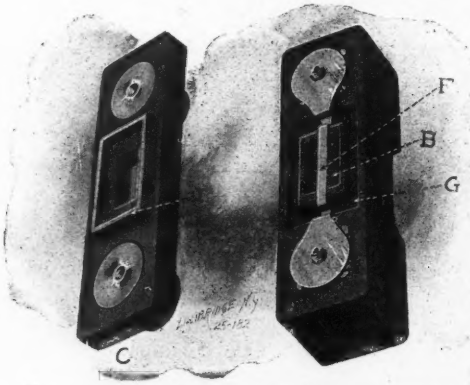


FIG. 4.—HIGH CAPACITY FUSE, S. K. C. SYSTEM.

whether the fuse is intact or not. The grooves facilitate the grasping of the combination to remove it from the board.

A Large Single Multiple Switchboard.

The Frontier Telephone Company, Buffalo, N. Y., is having constructed for it probably one of the largest single multiple switchboards that has ever been built, having a capacity of 18,000 lines. The specifications are very severe in their requirements and demand that the front of the switchboard must be so arranged that the distance from the key-shaft to the top of the multiple jacks should not be higher than thirty-five inches and that the operator must be able to have within easy reach 18,000 multiple jacks, 200 answering jacks and lamps for herself, and a sufficient number of outgoing and recording trunk lines.

The only possible way of meeting these requirements was to put the jacks on three-tenth-inch centres, being the smallest that have been ever used. The present

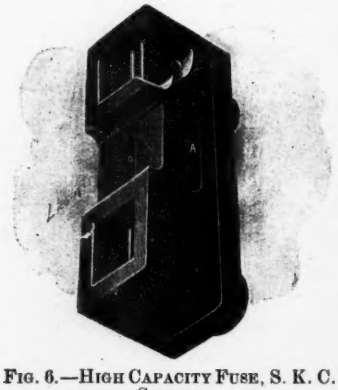
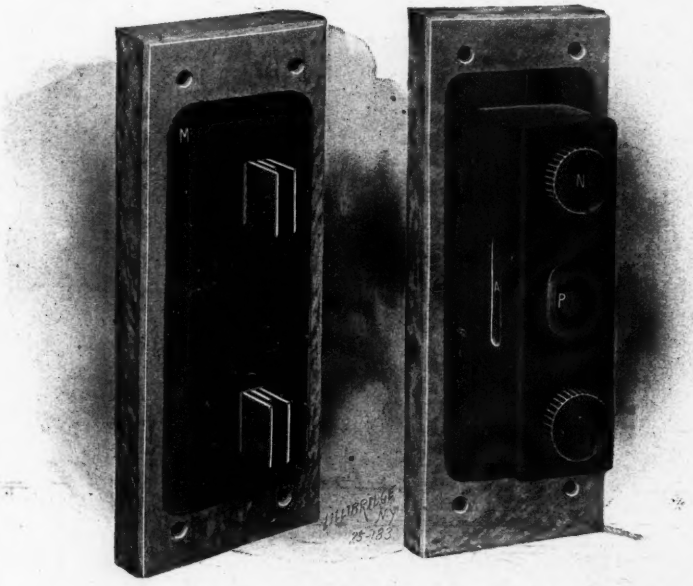


FIG. 6.—HIGH CAPACITY FUSE, S. K. C. SYSTEM.

equipment is to consist of twelve sections with a capacity of 4,800 lines. In addition there is a large trunk equipment provided for. The system is, of course, to be the latest common battery relay system. The power plant will be practical in all respects, having a gas engine reserve so that there is no possibility whatever of crippling the service. The desk equip-



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The Electric Equipment of the United States Mint.

In the new Philadelphia mint the metal is electrically treated from the time it enters the building until it leaves it. Electrical current is used for refining, and the rough ingot is top and rolled, cut and weighed, all in motor-driven machines, when an acid bath leaves it ready for the coining machines, which are a unique application of a small motor driving a large flywheel of sufficient momentum to ensure a heavy pressure at the instant of stamping. Nearly the entire installation is of the Crocker-Wheeler manufacture, eleven new motors having been added to the already large equipment during the month of March, bringing the total number furnished up to 120, besides four generators aggregating 625 kilowatts.

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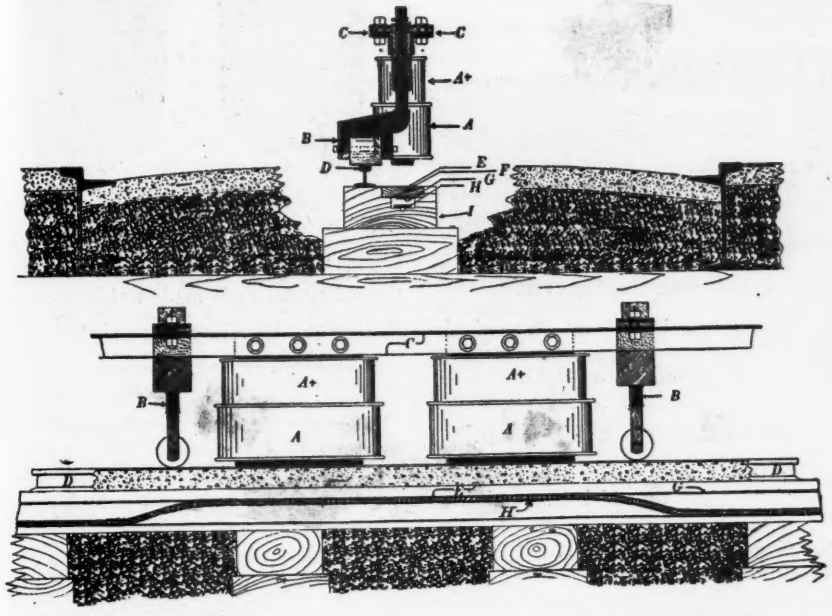
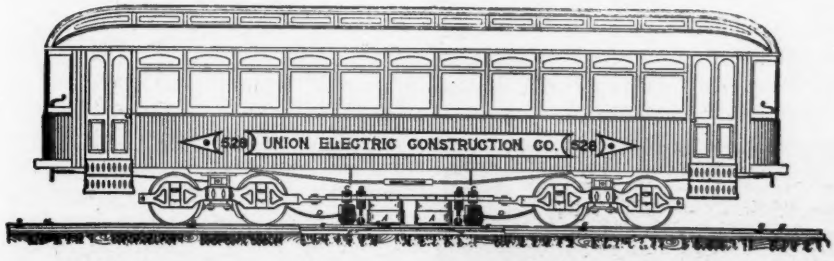


The Closed-Conduit System of Car Propulsion, Showing Track Construction for City Service.



Type of Car Used on Closed-Conduit System, Showing Detail of Connections.

New Automatic Current-Controlling Apparatus.

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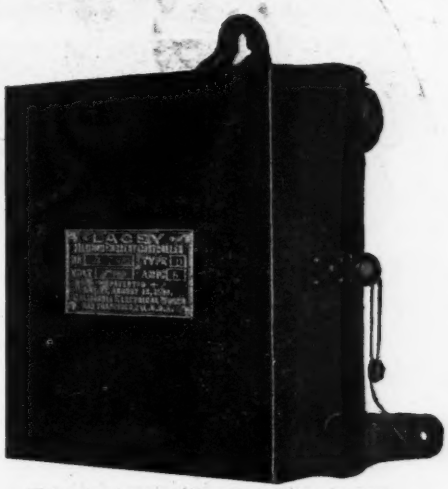

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New Automatic Current-Controlling Apparatus, Showing Interior Arrangements.

place the tongue fits snugly into the groove bounding the discharge chamber effectively confining the exit of molten

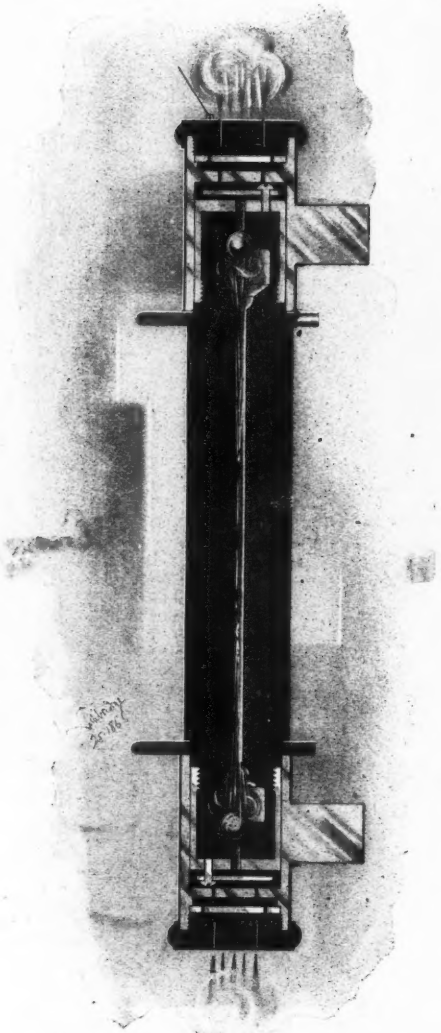


FIG. 3.—AT MOMENT OF FUSING.

fuse to the rear, as is shown in Fig. 6. The opening is covered with a piece of mica and provides means for observing

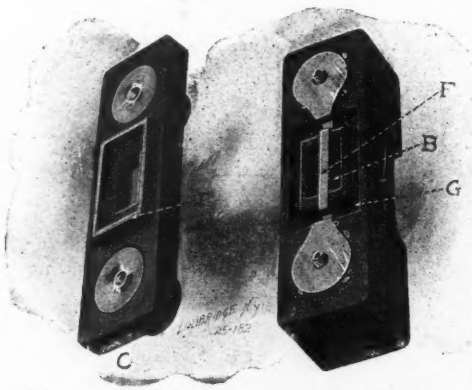


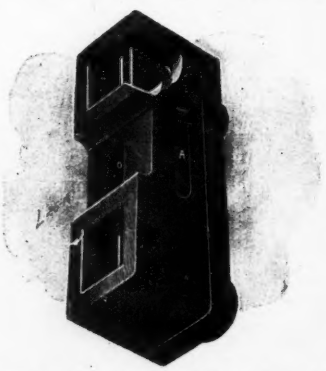
FIG. 4.—HIGH CAPACITY FUSE, S. K. C. SYSTEM.

whether the fuse is intact or not. The grooves facilitate the grasping of the combination to remove it from the board.

A Large Single Multiple Switchboard.

The Frontier Telephone Company, Buffalo, N. Y., is having constructed for it probably one of the largest single multiple switchboards that has ever been built, having a capacity of 18,000 lines. The specifications are very severe in their requirements and demand that the front of the switchboard must be so arranged that the distance from the key-shaft to the top of the multiple jacks should not be higher than thirty-five inches and that the operator must be able to have within easy reach 18,000 multiple jacks, 200 answering jacks and lamps for herself, and a sufficient number of outgoing and recording trunk lines.

The only possible way of meeting these requirements was to put the jacks on three-tenth-inch centres, being the smallest that have been ever used. The present



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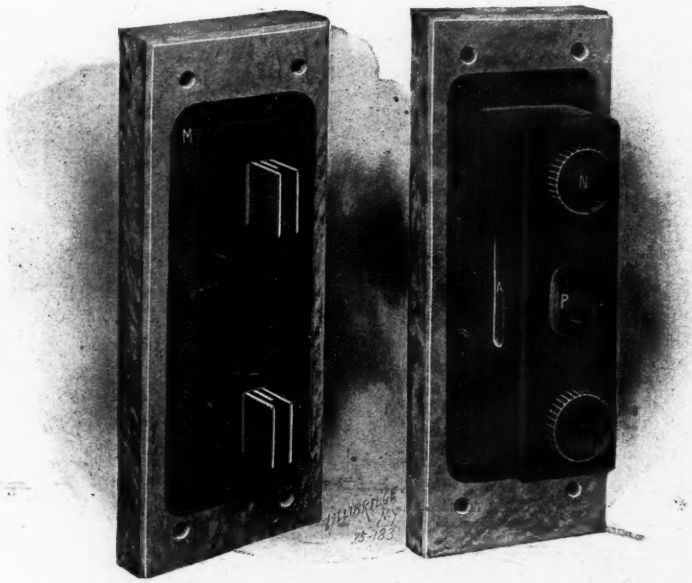

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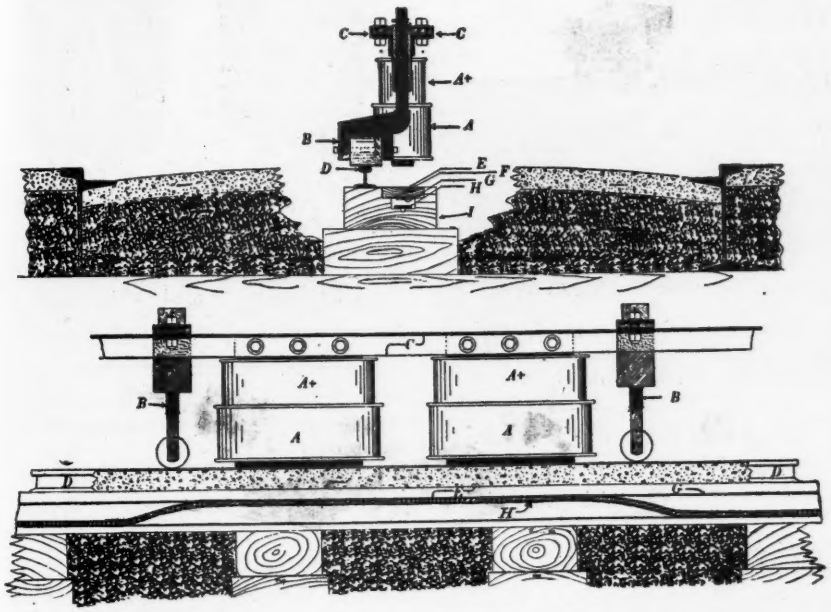

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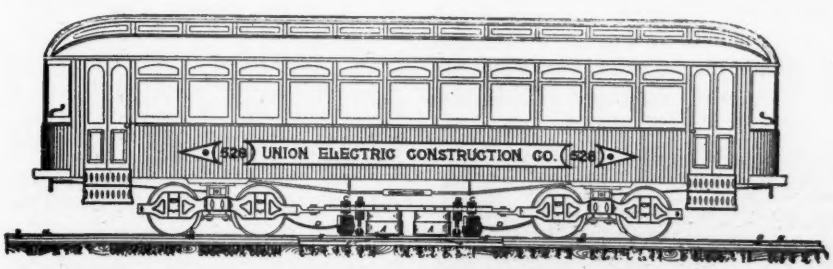

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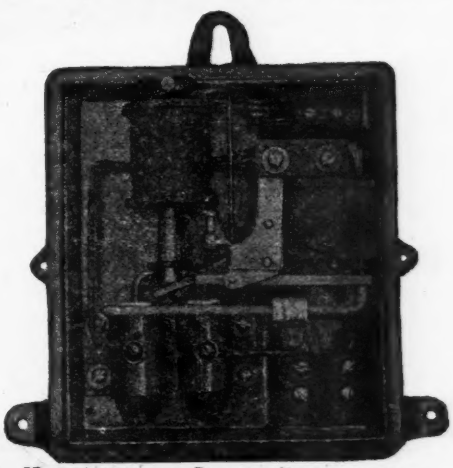


New Automatic Current-Controlling Apparatus, Showing Interior Arrangements.

A New Terminal Head.

That the telephone manufacturers are ever alive to the requirements in their special field and are utilizing every effort of inventive genius to bring forth new ideas for the protection and proper maintenance of lines is shown by the constantly increasing number of devices and appliances which are produced from time to time.

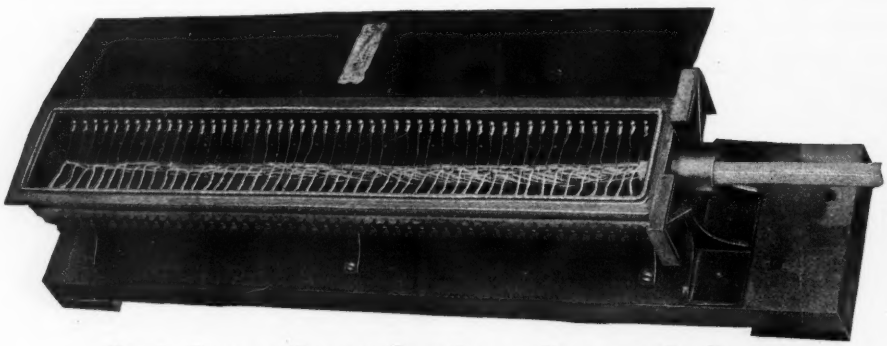


FIG. 1.—TERMINAL HEAD FOR FIFTY PAIRS OF CABLE, WITH LID REMOVED.

In the accompanying illustrations are shown a number of views of the new Becker terminal head, which has just been placed on the market by the Central Telephone and Electric Company, St. Louis, Mo., and which is meeting with considerable success. Fig. 1 shows one of these constructed for fifty pairs, with lid removed exposing the interior, with the cables installed. Fig. 2 shows a twenty-five-pair with the lid secured to head, showing a side view of the Becker terminal head with fuses in position. The ground-plate is directly beneath these and the fuses are of a novel construction, making this terminal head a practical and excellent protection against light or sneak currents, or from high-potential currents from any source. Fig. 3 shows the galvanized iron cover, which is furnished with a handle by which it may be placed in position or removed with very little trouble.

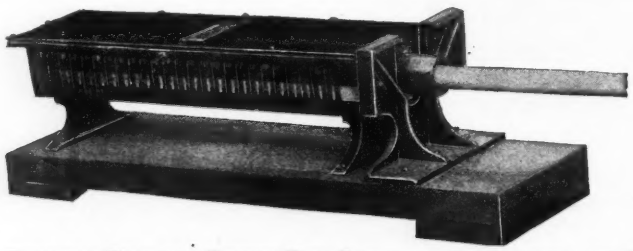


FIG. 2.—TERMINAL HEAD FOR TWENTY-FIVE PAIR, WITH LID SECURED, AND SHOWING FUSES IN POSITION.

FIG. 3.—GALVANIZED IRON COVER FOR TERMINAL HEAD.

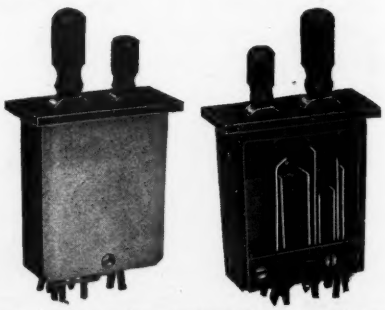
Figs. 4 and 5 illustrate a new switchboard cam which has also been recently brought out by this company, and shows the cam with the cover and with the cover removed. This cam is well constructed and is made to operate the listening circuit in multiple with both cords, or to ring either cord separately. It is furnished with platinum contacts and the maker claims has the peculiar advantage of being very compact and rigid.

Third-Rail Insulating Switch.

In the accompanying illustration are shown the features which are embodied in the Gale safety switch for insulating third rails, manufactured by the Metropolitan Electric Third-Rail and Traction Company, Boston, Mass.

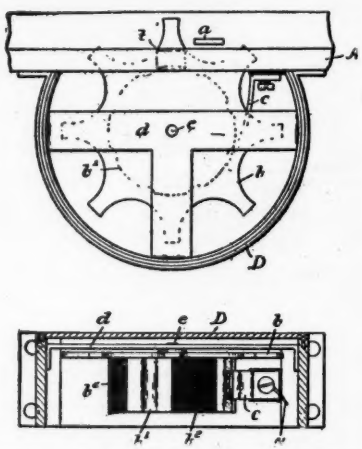
By using this switch the electric current is confined to the rail immediately beneath the motor car. As soon as the car has passed over it the rail becomes immediately "dead" like the rest of the track and will so remain until the little switch is automatically turned by the next car or train following.

Referring to the illustration, A is the third rail, (a) the shifting bar from the car, (b) the toothed wheel for engaging the shifting bar of car and b^1 the contact disc, b^2 is the insulating material, D is the casting, d the spider, and c the contact spring connected by wire with one of the cables.



FIGS. 4 AND 5.—SWITCHBOARD CAM, WITH COVER AND WITH COVER REMOVED.

For surface railways, the small box which is attached to the rail containing the safety switch is made water-tight, and the manufacturer claims that this may be attached to any form of electric third-rail railway systems at a minimum of expenditure.



THIRD-RAIL INSULATING SWITCH, SHOWING DETAIL OF CONNECTION.

The Electric Club.

The engineers and apprentices of the Westinghouse Electric and Manufacturing Company, many of whom are college graduates, feeling the necessity for closer union and cooperation have formed the Electric Club. The annual meeting at which the constitution was adopted by 150 charter members has been held. Comfortable and commodious quarters have been secured in the Hamnett Building, Wilkinsburg, Pa. The club is supported by the dues of the members, supplemented by a subscription from the company.

A new electrical company has been formed in Madrid to develop about 3,000 horse-power from a waterfall on the Jarama River, about eleven miles from Madrid. It is understood that the equipment will be purchased in the United States.

News from Great Britain.

(By Our Special Correspondent.)

THE Post Office central telephone exchange is now in operation, something over 200 subscribers being connected up, and additional ones being put on with great speed. Nearly 3,000 agreements have been entered into over the entire London area, and three other exchanges are in a position to commence working. Four more will be ready by the end of the year and a few others are being arranged for.

In this connection a reference to the accounts of the National Telephone Company for the latter half of 1901, which have just been issued, will be appropriate. From these it would appear that during that period the income has increased by £69,402, and the expenditure by £39,738. The net profit increased by £27,000 and amounted to £222,566, and the dividend is equivalent to five per cent on the ordinary shares, now divided into deferred and preferred stock. The Post Office royalties amounted to £73,423. In the chairman's speech at the twenty-ninth ordinary general meeting of the company reference was, of course, made to the agreement between it and the Post Office. As a refutation of the disparaging remarks which had at various times been hurled at the company in respect of the so-called worthlessness of its equipment and plant, the chairman informed the shareholders that during the last half year in London alone no less than £110,989 had been spent in equipment and maintenance of the company's service. Toward the end of his speech he drew comparisons between the charges in London and those obtaining in Boston, New York and Chicago, in which cities he said the rates were, respectively, £32, £48 and £35. It may be mentioned that the company has several bills in Parliament seeking extensions of its areas, etc., in certain parts of the country.

The London County Council, which was recently generously applauded both in the technical and lay press for keeping the contracts for the electrical equipment of its conduit tramways in the hands of home manufacturers, is now being grumbled at for letting the tenders for rails to a Scotch firm with a permission to sublet in Belgium. Happy is the public department which always pleaseth. Another little matter requiring careful negotiation by the Council is that of the electrification of the tramways in the northern suburbs. The horse tramways in this part of London are at present in the hands of a company which, under its lease with the London County Council, has to convert to electric traction at the expiration of a certain time and with due notice. Such notice has now been served by the Council, which, however, wishes to force the company to adopt the expensive underground conduit system which the Council itself is adopting in the much more densely populated South London. As the majority of the northern lines run through spacious roads and congestion of traffic only happens at one or two notorious points, the North Metropolitan Tramways Company asks to be allowed to adopt the overhead trolley except at these points. To the majority this seems to be a reasonable request, but the decision of the Council is not yet known.

To those gentlemen and others—and there are many—who never tire of twitting the government with regard to the elongated South African War, another opportunity is afforded of consoling themselves that this said war is really retarding general progress at home. Consequent on the serious breakdown in the telegraphic and telephonic communication with Scotland and the North last December, a deputation recently waited upon the Postmaster-General urging the necessity of providing increased facilities in the direction of more underground cables, and so guarding against another expensive interruption during bad weather. The gist of the Postmaster-General's reply was that, while admitting the justice and necessity of the request, the South African War expenditure rendered such a course undesirable at the moment.

A good deal of friction has been existent for some time now between the City Corporation and the City of London Electric Lighting Company as to the contracts under which the streets are now lighted. An acute stage in the negotiations has now been reached and notices of appeal to the House of Lords have been lodged by both parties. In the meantime the company has agreed to continue the lighting under the old terms.

The remarkable success of Marconi in his transatlantic wireless telegraphy has, as was to be expected, not been accepted by every one, and the proverbial bump of caution in certain quarters has created a sort of a storm in a teacup between Marconi and his supporters and a certain section of our electrical press, which is said to be "wedded" to the cable industry. To the superficial and non-interested observer, investors in cable enterprises, following the usual custom of financiers generally, certainly appear to have unduly excited themselves as to the immediate possibility of a deterioration in the value of cable shares, and probably with the object of allaying this misplaced anxiety, that portion of the technical press in question took the opposite view of the situation, and so worked itself into the bad books of the Marconi people. Marconi himself, in his speech at the annual meeting of his company, made a specific reference to this action, a proceeding which inspired a somewhat deliberate rejoinder in the columns of one particular journal. However, the fact that this particular newspaper has always extolled the virtues of Marconi's system is sufficient indication that their so-called aspersions upon the merits and possibilities of his signals were merely calculated to have the effect of preventing Marconi from degenerating into one of those "here to-day and gone to-morrow" enthusiastic inventors by indulging in too much daily newspaper "puff," of which there appeared to be a decided possibility at the time of the receipt of his famous "S" signal. Only the most blinded partisan would attempt to depreciate the importance of the experiments and results of Signor Marconi, and the rather obvious conclusion would seem to be that he has taken his critics too seriously, a somewhat pardonable offence on the part of a man in his position.

A somewhat interesting sequel to the *contretemps* above recorded happened in the House of Lords when the Postmaster-General was asked if it was a fact that the reason why Marconi's wireless telegraph system was not commercially in operation in Great Britain was the telegraphic monopoly claimed by the government. Lord Londonderry, the Postmaster-General, replied that outside the three-mile limit of our coast no license was required by Marconi's company, but the government was at present unable to give facilities for its use overland.

It had not yet been proven to him that the system could be worked more economically and efficiently than the present method. As to operations within the three-mile limit, experiments were being conducted by the Admiralty and these must be protected, and he was not yet convinced that Marconi's system could be used over the same waters as those upon which the Admiralty was experimenting without interference with the work of the latter.

A bill has just passed the committee stage of the House of Commons allowing for the construction of a canal between Rochester and Chatham, in Kent—about five miles—upon which the haulage is to be by electric trolley traction.

The projected express electric railway between London and Brighton, which promised such quick and cheap communication for Londoners to the seaside, will not proceed this session owing to a non-compliance with standing orders.

In 1903 the Institution of Electrical Engineers will pay a visit to Italy, and for the first time since these annual excursions into foreign countries were inaugurated, the members as a body will stay at home during the coming summer.

It will probably be remembered that last session a bill for the construction of an electrical transporter bridge across the River Tyne between North and South Shields was thrown out by a select committee of the House of Commons, principally owing to the target such a bridge would afford an enemy in time of war and so possibly being the means of blocking the traffic on England's most important ship-building and ship-repairing river. Some communication between the two towns in question is absolutely necessary, however, and it is satisfactory to note that a scheme for an underground electric railway has now been passed by Parliament.

Some time last year I gave an illustration of the arc lamps on the walls of the Victoria Embankment, London, the lighting of which was then inaugurated by the London County Council. Since then, however, the installation has been completed, and the accompanying view depicts one of the road standards.

The latest announcement in connection with the "Circle" railway dispute in London is that the Metropolitan company, following the example of the District company, has let the contract for its generating station equipment to the Westinghouse company. The accounts of the District company for the last half year show a decrease in receipts of nearly £12,000, and of profits over £16,000. The company is now feeling the effects of the London United Electric Tramways in the West as well as the Central London in the city. The periodical wail against its sister company's action in the matter of electrification is again included in the report. From general appearances it would appear that some lines outside the Circle will be the first to reap the advantages of electric traction. Thus an extension from Whitechapel to Bow has been dealt with in this manner first hand, and it is expected to be put in operation about May. Contracts have also been let for other lines.

THE LIGHTING STANDARDS OF THE VICTORIA EMBANKMENT, LONDON.

The Nernst lamp, the product of the Allgemeine Electricitäts Gesellschaft, is at last on sale in this country.

The Wolverhampton Corporation, which has made such a radical departure from the average practice in electric tramways in this country by adopting the Lorain surface contact system, recently called in an independent expert to report as to the wisdom of the Council should it decide to equip the whole of its system in this manner. This gentleman has now reported that from a careful inspection of the experimental line he sees no reason to advise the Council against such a course. The exhibition in this town will be opened on May 1. It is expected not to fall far short of the importance of last year's Glasgow Exhibition.

A. W.

London, March 22.

A Reception at Columbia University to Lord Kelvin.

On April 21, 1902, the American Institute of Electrical Engineers and Columbia University will give a reception at the university in honor of the Right Hon. Lord Kelvin (past-president of the Royal Society, honorary member of the American Institute of Electrical Engineers and of the American Physical Society) and Lady Kelvin.

The National Academy of Sciences, the American Association for the Advancement of Science, the American Mathematical Society, the American Physical Society, the Astro-Physical Society of America and the New York Academy of Sciences will be associated with the American Institute of Electrical Engineers and Columbia University in this reception. President Eliakim Moore has remarked that this will be a "delightful expression of international scientific unity." Falling as it does on the Monday following the installation of President Nicholas Murray Butler, there will be present at this gathering a number of distinguished visitors. The reception will be from 8.30 to 11 o'clock in the evening. Four speeches by prominent scientists will be made, with a response by Lord Kelvin. Tickets will be issued only to members and one lady at first, and if after returns have been made the capacity of the hall admits, guests may be invited. Persons desiring to attend the reception who are not members of any of the above societies will be given invitations by applying through the members. Dr. Francis B. Crocker is chairman of the executive committee for the reception and Mr. Calvin W. Rice is the secretary.

Safety Insulated Wire and Cable Company.

A syndicate formed by Messrs. Zimmerman & Forshay, bankers, of New York, has acquired the interests of the Safety Insulated Wire and Cable Company, of which Mr. Leonard F. Requa has been the general manager for many years. This company is one of the prosperous insulated wire and cable manufacturing concerns of the United States, and has recently acquired large factory and waterfront properties at Bayonne, installing the newest machinery to produce submarine cables of any desired length. It has recently done a large business in furnishing cables to the government at Manila. Mr. Requa will continue in the board of directors, and will retain an active interest in the business affairs of the company.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

ST. PETERSBURG UNDERGROUND—It is reported that an American has secured the contract for the erection of the St. Petersburg Underground Electric Railway, which it is understood will cost $41,200,000.

WEST AUSTRALIAN TROLLEY CONCESSIONS—It is considered certain in West Australia that the concession for the construction of an electric traction system at Boulder will be granted to the Kalgoorlie Electric Tramways Company, a London concern, which is being built with American equipment.

THE SPECIAL FRANCHISE VALUATION FOR 1902—The State Board of Tax Commissioners at Albany, N. Y., has fixed the valuation of special franchises, operating in New York city for the current year, under the special franchise tax act. The aggregate amount of the valuation is $220,620,155 as compared with $210,306,931 in 1901.

GERMAN-CHINA TELEGRAPHY—An agreement has been concluded between the German post authorities, the German and Marine Telegraph Company, the Indo-European Telegraph Company and other cable companies concerned in the transmission charges between Germany and China. The new charge, which came into force March 15, amounts to forty-seven cents per word as compared with $1.43 hitherto, the only condition being that the telegram be written either in German or English. Telegrams will be despatched to all parts of China without delay in transmission or increase in tariff.

PORT CHESTER ROAD PLANS—It is expected that everything will be completed in two years on the New York & Port Chester Railroad. The granting of the franchise will be followed immediately by the building of a four-track system, and 5,000 men will be put to work on the four sections into which the road will be divided between 132d street, New York city, and Port Chester. The work will be in charge of a construction company headed by John B. McDonald, the subway contractor. Banking interests representing $20,000,000 are behind the scheme, although it is not expected that the cost of construction will be more than half that amount. A power-house with a capacity of 20,000 horse-power will be built on City Island.

THIRD-RAIL LINE FROM NEW YORK TO ALBANY—The surveys for the proposed new Midland third-rail trolley line between New York and Albany have been completed, and as soon as maps can be prepared and filed the construction of the road will be started. The president of the company will be James S. Clarkson, of New York. It has been announced that the Vanderbilts are interested in this enterprise, and that a further line between New York and Buffalo is contemplated. The right of way has been pretty well provided for, options having been obtained on two-thirds of the land needed. Connections are offered at Hudson by the existing third-rail trolley to Albany, and from Carmel to New York by the New York & Northern.

LIGHTING AND TRACTION EQUIPMENT IN GREAT BRITAIN—Several important contracts are now pending in connection with electrical equipment for lighting, traction and general power work throughout Great Britain. The Walsall Corporation has decided to expend nearly $600,000 for extensions to its tramway system, and over $100,000 for its generating plant. The municipality of the Yorkshire seaside resort, Scarborough, is to expend some $240,000 for an electric traction system. Southport, a seaside place near Liverpool, will let contracts aggregating over $150,000 for additions to the electricity works. Grimsby, one of the fish centres on the east coast, has appropriated $90,000 for lighting purposes; and the city of Coventry intends to expend about $130,000 for light and power plants.

PENDING ELECTRICAL DEAL—A deal is about being completed in Baltimore, Md., between the Susquehanna Electric Power Company and the United Railways Company, which controls all the street railways and the lighting of this city. The contract is to cover the purchase of the United Electric Light and Power Company by the Susquehanna company, and the supplying of electric power to the United Railways. It is reported in United Railway circles that the purchase price of the United Electric Light and Power Company will be $1,250,000 in cash. This will be paid to the United Railways for the $2,000,000 of common stock of the United Electric Light and Power Company. The plans of the Susquehanna company contemplate three developments of 40,000 horse-power each on the Susquehanna River, above Post Deposit. This power will be brought to Baltimore for distribution by the United Electric Light and Power Company. The Continental Trust Company, of Baltimore, has the financial plans in charge.

SYNDICATE TO CONTROL WIRELESS TELEGRAPHY IN UNITED STATES—It has been reported in the daily press, New York city, that a group of financiers will form a company with a capitalization of $6,000,000 to control the American rights for wireless telegraphy. Mr. Marconi is quoted as having said at the dinner of the British Schools and Universities at the New York Athletic Club that Mr. Willard R. Green had arranged the transaction, but that back of it was E. Rollins Morse, the banker, who had purchased the patents and rights for the entire system for the United States, Cuba, Porto Rico, Danish West Indies, Alaska, the Philippines, the Hawaiian Islands, and the waters adjacent to them. The parent company is the London company. It is understood that the idea is to establish a route of communication direct to the Orient and to Russia, all on American territory. The new company will be known as the Wireless Telegraphy Company of America, and, as announced, will be incorporated very soon under the laws of New Jersey.

ELECTRIC LIGHTING

WELLINGTON, KAN.—The city council has let the contract for an electric light plant, which is to be completed and in operation by July 10.

ROCHESTER, N. Y.—Plans have been completed for the purchase of the Municipal Gas and Electric and the Citizens' Light and Power companies by the Rochester Gas and Electric Company.

ISLIP, L. I.—The town board has granted a franchise to a number of residents of East Islip to form an electric light company. It is the intention of the parties interested to at once erect a building and install a first-class plant.

COLVILLE, WASH.—T. A. Winter and W. L. Bowen are planning to install an electric plant at the falls of the Little Pend d' Oreille, eleven miles east of the town. Electric power will be conducted to Colville for lighting and power purposes.

NEWTON, N. J.—At a recent meeting a resolution to raise a fund for street lighting by electricity was carried and steps were taken to begin immediately the erection of an electric light plant. The dynamos will be driven by water power of which there is a plentiful supply.

HACKENSACK, N. J.—The Bergen County Gas and Electric Company has been reorganized in Hackensack with E. A. Pierce as manager and treasurer. The new management has decided to consolidate the Rutherford and Englewood branches under one general management in Hackensack.

FAIRHAVEN, N. Y.—A stock company has been formed under the name of the Moravia Electric Company to supersede the Moravia Electric Light, Heating and Power Company. The directors of the new organization are: F. P. Tabor, president; W. J. H. Parker, vice-president; H. M. Jewett, secretary and treasurer.

BELVIDERE, ILL.—A petition is being circulated among the property owners for the purpose of gaining consents for the establishment of a heating and lighting system through the streets of the city. When a franchise is granted a central station will be built and the supplying of hot water for heating and electricity for lighting begun at once.

ENSLEY, ALA.—W. T. Terry and associates of Ensley have been granted a franchise for the building of an electric light and power plant in Ensley. Under the contract the city receives corresponding benefits. The city hall and all public offices will be lighted free of charge during the entire life of the contract. Attorneys for W. T. Terry and associates have been instructed to make the necessary preparations for the incorporation of the concern which will be capitalized at $50,000 with the privilege of increasing to $100,000. A site comprising three and one-half acres of ground is already owned by one of the gentlemen interested and will be conveyed to the corporation as soon as formed.

TELEPHONE AND TELEGRAPH

INDEPENDENCE, WIS.—The Osseo Telephone Company has been granted a franchise to put in a telephone system at Fairchild.

LA CROSSE, WIS.—The Northern Electrical Construction Company has been organized for the purpose of financing and constructing telephone systems, electric and lighting systems and street railways.

WINFIELD, KAN.—Communication has been established between Dexter and Winfield by the Winfield Telephone Company. The Winfield Telephone Company is building a system to cover the whole of Cowley County.

SHERIDAN, WYO.—The Powder River Telephone Company has begun building the line from Buffalo to Kearney, where it will connect with the Sheridan Telephone Company, making a through line from Buffalo to Sheridan.

TOLEDO, OHIO—The Toledo, Telegraph, Telephone and Messenger Company expects to begin construction within the next month and to have its system in operation within three months. The plant which the company expects to install will cost $100,000.

WATERVILLE, ME.—At the recent special and annual meeting of the stockholders of the Dirigo Telephone Company of Maine, the name of the corporation was changed by a unanimous vote to "Northeastern Telephone Company." At the same meeting, the capital stock was increased to $500,000.

BUTTE, MONT.—The Postal Telegraph and Cable Company has secured the right of way for a pole and wire line along the Oregon Short Line Railroad from Butte to various points in Montana and to Ogden, Utah. The right of way through Idaho and Utah has already been secured.

PHILADELPHIA, PA.—Negotiations are said to be under way for the transfer of the Keystone Telephone Company's interests to the United Telephone and Telegraph Company. Street rumors, however, are to the effect that a deal may be made with the Bell Telephone Company.

SOUTH PITTSBURG, TENN.—The Cumberland Telephone Company has absorbed the Dixie, a local company, with headquarters at Tracy City. The Cumberland people will at once proceed to take out the old telephones of the Dixie system and replace them with more improved long-distance instruments.

NEWPORT, NEB.—The Newport-Mariaville Telephone Company has completed its telephone line from this place to Mariaville. With the completion of this line over fifty miles of independent telephone line has been built during the past year by Rock County parties, and almost fifty miles more are contemplated for the coming summer.

ALMA, MICH.—At the annual election of officers for the Union Telephone Company, Stanley E. Parksill, of Owosso, was elected president. C. O. Trask was reelected general manager. The capital stock was increased from $250,000 to $400,000. The past year, as shown in the annual report, was the most prosperous in the history of the company.

SIOUX CITY, IOWA—C. H. Smith, secretary and manager of the New State Telephone and Telegraph Company, has been investigating the prospects for establishing a telephone exchange at that place and connecting it with the exchange of the Piero company, which is putting up telephones for farmers in that vicinity. It is stated that the people of Anthon want an exchange.

WATERVILLE, N. Y.—A new telephone line is being built from Clinton to Paris Hill by way of Chuckery and Crow Hill. The coming summer a line will be built to Middlesettlement, by way of Utica street, and from Middlesettlement will probably be continued to Kirkland; this will cover a territory which has no local system, and will no doubt be popular.

TERRE HAUTE, IND.—The Citizens' Telephone Company has a force of men working in the west end of the county toward the state line to connect with the telephone line from the Illinois towns in the neighborhood. The line from Illinois connects with Marshall, Greenup, Casey, Charleston, Westfield, Kansas and Mattoon, all in Illinois, and with the line to Sullivan, Ind.

DELMAR, DEL.—A new telephone company to be known as the Pocomoke Telephone Company has been chartered with a capital of $150,000. The directors of the new company are: William S. Schoolfield, I. H. Merrill, Emerson G. Polk, E. James Tull, Franklin W. Byrd, Robert J. Lambden, James S. Clogg, J. Shiles Crocket, James P. Blaine, John W. Ennis and William H. Walters.

AUSTIN, TEX.—The Southwestern Telegraph and Telephone Company, which operates in Texas and Arkansas with principal office at Dallas, has in contemplation the expenditure of a sum of money in this state in extending and building new toll lines and otherwise enlarging and improving its telephone system. An investigating committee has submitted and has approved an estimate of $250,000 for improvements.

ALBION, MICH.—Following the telephone mass meeting held recently, the businessmen's committee is circulating a paper pledging support to the Independent telephone exchange, conditional upon the same starting out with 300 subscribers. The committee reports that it is meeting with great success. The canvass is only just nicely under way, but already over half the required number of subscribers have been obtained.

BROOKLYN, N. Y.—The New York & New Jersey Telephone Company is planning to increase its suburban service and has commenced the construction of a new telephone exchange which will take the place of the East New York Central. The company also expects to build a new Prospect exchange, a new exchange in Bay Ridge, and will enlarge several of its buildings that have now outgrown the business that has been accumulated.

CARBONDALE, PA.—Both the Carbondale Telephone Company and the Pennsylvania Company are planning extensions and other changes that will greatly increase the efficiency of the service of each in this city and vicinity. The Carbondale company is going to install another section of switchboard, which will mean accommodations for 100 additional telephones. Extensions of the system will also be made, giving service to Dundaff and Crystal Lake; also to points north of the city.

COHOES, N. Y.—Men have begun the work of erecting poles in this city for the stringing of wires for the Cohoes & Waterford Home Telephone Company. The work will be pushed as rapidly as possible and it is expected that before the summer months have passed the company will have its lines in full operation in this city. Several sites for the main office of the company have been looked over by the officials of the company, but as far as can be learned there has been no definite decision as to where the office will be located as yet.

NEW INCORPORATIONS

LAWRENCEVILLE, ILL.—Lawrenceville Light and Water Company, Lawrenceville. Capital increased from $25,000 to $32,000.

SPRINGFIELD, OHIO—The Springfield & Washington Traction Company. $100,000. Incorporators: D. King Gotwald, O. F. Dillman, Lee B. Corry and others.

FRANKFORT, KY.—People's Independent Telephone Company, of Paducah. $150,000. Incorporators: Fred Hillman, J. P. Gosman, W. M. Sharp and John Tusner.

ALBANY, N. Y.—The New York & Jersey City Terminal Underground Railroad Company. $100,000. To construct a tunnel railroad between New Jersey and Manhattan borough.

ALBANY, N. Y.—The East Creek Electric Light and Power Company, of St. Johnsville. $200,000. Directors: Guy P. Beardslee and Ethel Beardslee, of East Creek, and Charles E. Snyder, of Herkimer.

LOS ANGELES, CAL.—The Western Power Company. $5,000,000, of which $500 is subscribed. Incorporators: T. L. Neal, A. L. Stephens, B. D. Neighbors, T. H. Hastings, W. H. Anderson, all of Los Angeles.

GUTHRIE, OKLA.—The Comanche Light and Power Company, of Lawton. $50,000. Incorporators: W. M. McGreager, of Wichita Falls, Tex.; W. H. Anderson, George W. Broe, F. M. English and George M. Paschal, of Lawton.

ST. LOUIS, MO.—Rossiter-MacGovern Electrical Company. $5,000, paid. Clinton Rossiter has forty-six shares, and Frank MacGovern, Arthur B. Shepley, Thomas K. Skinker and Charles R. Skinker each has one share.

GUTHRIE, OKLA.—The Oklahoma Gas and Electric Company, of Oklahoma City. $600,000. Incorporators: Edward H. Cooke, George W. Wheeler, Henry W. Rule, A. B. Baird, W. W. Storm, William K. Gillett and Charles L. Ayling.

TRENTON, N. J.—The National Telegraphone Company; $2,000,000; to manufacture telegraph and telephone instruments; incorporators: Edmund L. Grannel, George E. Milligan, Allen E. Kirby, Carthage, N. Y. Union Railway Power and Electrical Company, No. 243 Washington street, Jersey City; $100,000; incorporators: N. R. Vanderhoof, W. Monds Greene, Edward Cuddy.

ELECTRICAL SECURITIES

A very much more active market resulted this week owing to the increased easiness in the condition at the closing of the market a week ago. Prices scored important advances in a number of active stocks. This strength of the market was due, however, in the main to extensive operations of western operators, who manipulated large blocks of the railroad stocks. The past week has been memorable in the financial history of the year, marking as it does the period when speculation has broken away from the sluggishness and apathy which have marked it almost continually since the first of the year. In spite of the bullish conditions prevailing, however, public interest increases but in a very small ratio, the largest commission houses reporting but little business, except in a small investment demand for the highest grade securities.

There has been very little heard of late in regard to the Northern Securities Company. As has been pointed out before, it will be strange if the financial community does not experience some perturbation of a greater or less degree, and this matter is being attended to with greater interest as the time draws near for the initial decision which will be made by the lower United States Court.

Prices for the future will be more or less guided by the crops and monetary reports, and although the money outlook has been made more stringent by the prospect of early gold exports and gold shipments abroad, it is believed that the banking interests are in a condition to take good care of any emergency in this direction.

ELECTRICAL SECURITIES FOR WEEK ENDING APRIL 5.

New York:	Closing.
Brooklyn R. T.	65¾
Con. Gas	226¾
Gen. Elec	325⅞
Kings Co. Elec	198
Man. El.	133¾
Met. St. Ry	165
N. Y. & N. J. Tel. Co	167
Telep., Tel. & Cbl. Co	5
Westinghouse Mfg. pf	197½

General Electric and Westinghouse made gains of 3 points for the week. The annual meeting of the General Electric Company will be held at Schenectady, N. Y., May 13. A special meeting will be held on May 5 to vote on a proposition to increase the capital stock to $45,000,000.

Boston:	Closing.
Am. Telep. & Tel	185
Edison Elec	270
Mass. Elec. pf	104
New England Tel	146
Western Telephone & Telegraph	106

The active features of the Boston market were Massachusetts Electric Common at 41, Western Telephone at 33, and preferred at 104. American Telephone and Telegraph went up to 185 and carried all the other telephone stocks with it. Edison Illuminating was also a live feature of the Boston market.

Philadelphia:	Closing.
Elec. Co. of America	7½
Elec. Stor. Bat. c	74¼
Elec. Stor. Bat. pf	74¼
Philadelphia Elec	5¼
Union Traction	43¼
United G. I. Co	122

Electric Storage Battery, United Gas Improvement and Union Traction were the stocks most dealt in in the Philadelphia market during the week, these features supplying 90 per cent of the dealings. United Gas Improvement advanced 2 points.

Chicago:	Closing.
Central Union Tel	40
Chicago Edison Light	175
Chicago Telep	175
Metropolitan El. pf	92
National Carbon	24½
National Carbon pf	90¾
Union Traction	19¼
Union Traction pf	57½

In consequence of the denial by Judge Tuley of the injunction sought for by the Union Traction to restrain collections on the franchise tax, the Union Traction Company has paid to the city $397,000 in taxes. The case will be carried to the Supreme Court, and should a reversal of Judge Tuley's denial be secured, this money will have to be refunded by the city.

PERSONAL MENTION

MR. E. H. ABADIE, the manager of the recently dissolved sales organization of the Bullock Electric Manufacturing Company and the Wagner Electric Manufacturing Company, has been retained to close out the affairs of that organization, and it is rumored that he is considering offers from other manufacturers, one of which would bring him to New York city.

COLONEL JOHN T. DICKINSON, who has heretofore represented the Consolidated Railway Electric Light and Equipment Company in Chicago, has been transferred to New York as general agent, with headquarters at the general office of the company, 100 Broadway, New York, and Mr. George W. Carhart has succeeded Colonel Dickinson as general agent of the company in Chicago and the West.

MR. WILLIAM C. CANDEE, assistant secretary of the Okonite Company, New York, and Miss Edna Burnett, of Newburgh, N. Y., were married on Wednesday of this week at the home of the bride's parents. The groom, who is a son of Captain Willard L. Candee of the Okonite Company, has received many congratulations from his electrical friends, and will reside in New York upon his return from a brief honeymoon trip.

MR. E. B. BAKER, for many years general superintendent of the Southern New England Telephone Company, will assume an executive position with the Gray Telephone Pay Station Company, of Hartford, Ct., beginning May next. Mr. Baker will have his offices in New York in the Postal Building, 253 Broadway. The Gray company manufactures some fifteen different kinds of pay telephones and has been quite successful in installing its apparatus with the telephone companies of the United States. Mr. Baker has been financially interested since it was first organized and will devote himself exclusively to the company's interest after this month.

ELECTRIC RAILWAYS

WEST LIBERTY, OHIO—The Dayton, Springfield & Urbana Electric Railway has commenced the construction of a line between Urbana and West Liberty.

AURORA, ILL.—An ordinance is to be introduced at the next meeting of the city council by the promoters of an electric line, for a franchise granting permission to operate in several streets of the city.

ALBANY, N. Y.—The Auburn Interurban Electric Railway Company has been authorized by the State Board of Railroad Commissioners to increase its capital from $250,000 to $1,000,000. The increased capital is made necessary to bring about new construction.

DAYTON, OHIO—Dayton investors are planning to equip the Columbus, London & Springfield Railroad Company with a third-rail system between Springfield and Columbus. It is probable that other divisions under the control of the Appleyard Syndicate will be similarly equipped.

SPRINGVILLE, N. Y.—The contract for building the Buffalo, Springville & Cattaraugus trolley road has been made. It is stated that the power-houses and carbarns will probably be built on the Erie County side of Cattaraugus Creek and the estimated cost of these is at least $60,000.

HANNIBAL, N. Y.—It is reported that parties are negotiating for the Lake Side Electric Road, of Syracuse, for the purpose of running a high-speed system to Oswego. It is said that there is sufficient water power on the Oswego River to generate all the electricity that would be necessary in order to operate the road, and this could be obtained at a comparatively low figure.

OLATHE, KAN.—The city council has been petitioned for a franchise seeking entries for a new line into the city from the north over to the old Santa Fe trail, with a station near the Avenue Hotel. It also provides for the erecting of a single track connecting the Santa Fe and Frisco passenger stations, the company proposing to run cars between the stations hourly or to meet every train. The company now has the right of way from the city limits of Kansas City to the city limits of Olathe and it is expected that active work will begin as soon as the franchise to enter the city of Olathe is granted.

CLEVELAND, OHIO—Notice of the granting of a temporary restraining order by Judge Bissette against the City, the Board of Control, John B. Hoefgen and the People's Street Railway Company has been served to prevent the beginning of the work on the proposed three-cent fare street railway. The order will be effective until the further determination of the court, and has been filed on behalf of William M. Reynolds who has given a bond for $2,500. It is alleged that the ordinance granting Mr. Hoefgen the privilege was illegal, and was an abuse of the proper powers of the city, and that the grant was made to Mr. Hoefgen without competitive bidding.

INDUSTRIAL ITEMS

J. H. BUNNELL & COMPANY, Park Place, New York city, has opened an office in the Monadnock Building, Chicago, where Mr. V. C. Grace, as representative, will take care of the wants of western supply jobbers.

THE CONOVER MANUFACTURING COMPANY, which has for the past six years been located at 26 Cortlandt street, New York city, has transferred its entire business to its new factory building at Princeton avenue, Jersey City, N. J.

THE GOULD STORAGE BATTERY COMPANY, New York city, has recently installed 216 cells, type O, 513, in lead-lined tanks, having a capacity of 100 kilowatts, to be used as a floating battery on the system of the Amherst & Sunderland Street Railway Company, Amherst, Mass.

THE BAIRD MANUFACTURING COMPANY, Chicago, Ill., reports that the use of its electric clock-switch is not confined to turning off electric lights. An enameling company finds it just the thing for turning off gas in enameling ovens at any stated time and has ordered one for that purpose.

THE GLOBE AUTOMATIC TELEPHONE COMPANY, Chicago, Ill., it is announced, has purchased the National Automatic Telephone Company. The business has been moved to 153 and 155 West Jackson street, where capacious quarters have been secured, doubling the former capacity.

THE BUCKEYE COMPANY, Cleveland, Ohio, has given considerable attention to the development of small candle-power lamps, particularly two and three-candle-power sign lamps, and the regular four-candle-power lamps. The company states that it is doing this in response to the increasing demand for small units.

THE PHOENIX ELECTRIC MANUFACTURING COMPANY, Mansfield, Ohio, announces that it has purchased the plant and business of the Card Electric Company. The plant changing hands is enabled by new capital to greatly enlarge its facilities and will broaden out into a larger and more extensive field of electrical industry.

THE BURNLEY BATTERY AND MANUFACTURING COMPANY, Painesville, Ohio, is the manufacturer of Burnley soldering paste. This material is non-corrosive, non-acid and is insulating in its nature. It is made from soldering juice, formed into a superheated steam and then forced into a greasy paste and will not sputter, making quick work and sound joints.

THE JAMES DIXON CRUCIBLE COMPANY, Jersey City, N. J., is distributing a unique reminder and souvenir in the shape of a four-leafed mailing card. Each section of the card shows in half-tones, of which there are eight, illustrations which will be of great interest to architects and engineers, of structures which are protected by this company's silica-graphite paint.

THE STANDARD POLE AND TIE COMPANY, New York city, has been awarded the contract for the poles to be used on the line of the Columbus, Delaware & Marion Electric Railway, running from Columbus to Marion, Ohio. The pole which will be supplied is of southern white cedar or juniper, which has, of late, become very popular for interurban lines, because of its symmetry and freedom from sap and butt rot.

THE FOSTORIA INCANDESCENT LAMP COMPANY, lamp and glass works, Fostoria, Ohio, main office, Cleveland, Ohio, reports great improvements in its high candle-power lamps during the past two or three months. The company has made this improvement a special study owing to the fact that high candle-power lamps have not relatively rendered as good service as the medium candle-powers.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has received from its publication bureau a magnificent catalogue descriptive of small motors. This catalogue sets forth the use of small motors for every variety of service and also illustrates controlling apparatus in connection with these small motors. The book is replete with beautiful illustrations, contains a comprehensive index and is a valuable addition to the company's literature.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, has shipped to Seattle, Wash., four batteries of chloride accumulators. One of these will be installed in the power station of the Seattle Electric Company for use with the railway machinery as a regulator of the fluctuating load and as a reserve. The three remaining batteries are for use on the Seattle & Tacoma Interurban Railway, and are to be used for regulating the great variations in load on this system.

THE PITTSBURGH ELECTRIC LAMP COMPANY, Braddock, Pa., is manufacturing incandescent lamps and is catering especially for the trade of local users of incandescent lamps and those users who are located in the middle section of the United States. The officers of the company are as follows: L. A. Drexler, president and general manager; J. J. Jennings, secretary, and H. E. Kelly, treasurer. Mr. Drexler was with the Sawyer-Man Electric Company, of Pittsburgh, before forming his present company.

LOUIS M. PIGNOLET, New York city, manufactures voltmeters and voltammeters for testing storage and primary batteries of all kinds and for general instruments. These are of the permanent magnet type and are made in a thorough manner, electrically and mechanically, on the same principles as that of large instruments. The magnets are of special imported steel and carefully aged. The pivots of the moving parts are hard and sharp and rest in jewels. Each instrument receives careful attention, and adjustment of the scale is made separately by hand.

THE CONSOLIDATED ENGINE-STOP COMPANY, New York city, is the manufacturer of the Monarch Engine-Stop and Speed Limit System. This is an additional safeguard and means of protection for life and property, entirely independent of any other mechanism connected with the engine for that purpose, being in fact a supplementary engineer. This system is applicable to every type of stationary engine. The stop is directly connected to the throttle and by means of electric wires and push-buttons is accessible in all parts of the building. Hundreds of users are enthusiastic over its efficiency, as a large number of testimonials received by the company evidences. Full information will be forwarded on request by the Consolidated Engine-Stop Company, American Surety Building, New York.

I. P. FRINK, manufacturer of Frink's improved reflectors, has made a careful study of the question of picture lighting and exhibition effects and has installed work for a great number of the prominent architects for lighting up a majority of the best galleries of the country. In a recent installation designed for the Lotos Club, 558 Fifth avenue, New York city, there was an average of about 100 lights used, the pleasant light with an entire absence of glare bringing out the full effects of the paintings of the Emerson McMillin exhibit, and giving great satisfaction to all interested. This system has been successfully used in over 20,000 installations in churches alone in all parts of the world. On receipt of necessary data, all necessary information will be gladly forwarded.

THE CONSOLIDATED RAILWAY ELECTRIC LIGHT AND EQUIPMENT COMPANY, New York city, announces that after two years' critical test the Atchison and Pullman companies have accepted as entirely satisfactory the 115 axle-light equipments used in the Atchison service, and all private Pullman cars are now being equipped with the electric car light system. This system is also being applied extensively upon the cars of the Missouri Pacific, St. Louis & San Francisco, Chicago, Great Western, Pennsylvania lines west of Pittsburgh, and other railways as well as upon the private cars of many railway officials. The equipment of the Consolidated Axle Light System consists essentially of a generator installed upon the truck of the car and driven from the axle, a regulator is installed in any convenient location in the interior of the car, and a storage battery hanging in a suitable box from the car body.

BOCH'S "GLAZE-FILLED" INSULATOR—In the controversy between the advocates of porcelain and glass insulators for high-tension transmission lines, it is conceded for porcelain that it has the advantage in respect to mechanical strength. The difficulty has been to make high-voltage insulators of porcelain uniformly free from flaws. When that has been accomplished it is believed that glass insulators can no longer claim superiority in insulating quality over porcelain ones. R. Thomas & Sons Company, of East Liverpool, Ohio, announces that its manager, Mr. J. W. Boch, has accomplished the task of producing a flawless porcelain insulator of superior insulating qualities as well as of great mechanical strength in his "glaze-filled" insulator. This insulator has gone into practical use during the past few years on high-tension lines all over the country and has met with marked success. Mr. Boch's patent (No. 600,475) has been recently sustained by the United States Circuit Court in an infringement suit against two other manufacturing companies.